UNITED STATES DISTRICT COURT FOR THE
WESTERN DISTRICT OF WISCONSIN

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POWERbahn, LLC,

Plaintiff,

Case No. 17-cv-003-wmc

v.

Saris Cycling Group, Inc. d/b/a CycleOps,

Defendant.

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**Expert Report of Dr. Bryan Bergeron**
**On The Invalidity Of The Patents-In-Suit**

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I have been retained by Saris Cycling Group, Inc. d/b/a CycleOps, the defendant in this case, to offer expert testimony regarding the validity of U.S. Patent Nos. 7,066,865 (the '865 patent), 7,608,015 (the '015 patent), 7,841,964 (the '964 patent), and 7,862,476 (the '476 patent) and the plaintiff POWERbahn's assertions of infringement against CycleOps. I provide this report of my opinions pursuant to Federal Rule of Civil Procedure 26(a)(2) and the Court's preliminary pretrial conference order (Dkt. No. 16).

## I. Background and Qualifications

1. My formal education includes a Bachelor of Science degree in Psychology, *with honors*, with additional emphases in physics and chemistry, from Tulane University in 1980. Prior to receiving my B.S. degree, I studied electrical engineering at Louisiana State University in Baton Rouge, Louisiana.

2. I obtained my Doctor of Medicine degree from Louisiana State University Medical Center in 1984, and completed a post-doctoral fellowship in Medical Informatics at Harvard Medical School/Brigham & Women's Hospital in 1987. I have taken formal courses in computer science as an undergraduate, in medical school, and as a post-doctoral fellow, and courses in electronics and advanced physics as an undergraduate. I also studied Radiological Monitoring, with a certificate from the University of Minnesota.

3. My academic career has included a variety of teaching, research and administrative positions at Harvard Medical School, MIT, HST, and Massachusetts General Hospital Institute for Healthcare Professionals. Over the course of 30 years, I have taught computer science, medical informatics, cardiac pathophysiology, and pulmonary pathophysiology.

4. I have developed many different types of physiological simulators during my career. For example, my first company, Home Health Software, in New Orleans, Louisiana,

focused on the development of simulation-based software for various types of medical analyses and planning that could be utilized by a lay-person on a home microcomputer. Home Health Software produced several commercial patient simulation software titles that were sold nation-wide, including *The Triathalog*, the first commercial personal fitness program on a microcomputer and *The Lean Machine*, the first commercial diet, nutrition, and weight management program on a microcomputer. *The Triathalog* software enabled users to optimize training for multiple sports simultaneously, and was also something I conceived of to support my triathlon training at the time. In late 1984, Apple Inc. provided me with hardware and technical support, including Certified Developer Status, so that I could develop similar medical simulation software for their new Macintosh Computer. I closed the company in 1985 when I moved to Boston to pursue my post-doctoral fellowship.

5. During my post-doctoral fellowship at Brigham & Women's Hospital and Harvard Medical School between 1985 and 1987, I developed HeartLab, the first commercial multimedia patient simulator for a microcomputer. HeartLab was sold and marketed by Williams and Wilkins Publishers, in Baltimore, Maryland, and was used in virtually every medical school in the United States, as well as many medical schools in Europe. After HeartLab, I went on to develop numerous other types of patient simulators for use in medical education.

6. In 1996, I founded Archetype Technologies, Inc., in order to offer consulting services to industry and compete for government funding. As the head of Archetype, I also served as Chief Scientist for various clients—generally startup companies or other small companies—including Kurzweil Technologies, Kurzweil Applied Intelligence, Medical Learning Company, and Accella Learning Company. In my work with Medical Learning Company and later Accella Learning Company, I developed simulation-based, interactive applications (e.g.,

using lifelike avatars with interactive voice recognition and speech generation) to teach and test clinicians how to diagnose and treat specific conditions. And for the past decade, through Archetype, I have served as the Principal Investigator on a series of US Department of Defense research grants that involved the development of hardware and software for intelligent tutoring (i.e., adaptive) systems for training civilian and military clinicians to respond to nuclear, chemical, and biological warfare events, using simulation and augmented reality technologies of my own design.

7. I also have extensive experience with computer hardware and software programming. For most of my simulators, I have written the relevant computer code myself. As a part of my academic research in medical informatics, I developed Natural Language Processing applications in LISP (*e.g.*, parsing medical language), PROLOG (*e.g.*, expert medical diagnostic systems), PASCAL, NEON, and SMALLTALK. The majority of my subsequent application programming work has been in the languages of C/C++, BASIC, PASCAL, a variety of scripting languages, a variety of expert system shells, and simulation engines, from MatLab to Extend. My database programming has been in SQL databases and numerous desktop and server-based databases that use scripting languages in conjunction with SQL-like statement. I have also developed web sites (e.g., the first web site at Massachusetts General Hospital) using JAVA and PERL. In my DoD-sponsored work, I have used C/C++ to control embedded microcontroller hardware that communicates with server databases.

8. I have held a variety of leadership posts in organizations focused on the application of computing. For example, I have served as Chairman of the Mathematical Modeling & Simulation Committee for the Symposium on Computer Applications in Medical Care ("SCAMC"), Chairman of the SCAMC Human-Computer Interfacing Committee, and

Chairman of the Healthcare Information and Management Systems Society ("HIMSS") Conference on Innovative Informatics for Reducing Medical Errors. I have also served on fourteen editorial boards for various publications related to medical informatics, including e.MD (Founding Editor-in-Chief), Physicians Home Page, Healthstream, Medical Software Reviews, WebMD/Medscape Tech Med, and Healthcare Informatics.

9. My publications include 11 patents, over two-dozen books, numerous chapters and over 500 articles on topics ranging from clinical medicine, technology, and robotics, to serious games. I am also editor-in-chief of two technology magazines, *Nuts & Volts* in the fields of electronics and communications, and *SERVO* in the fields of robotics and embedded systems. My CV is attached as **Exhibit A**, which includes a list of my publications, including all publications which I have authored in the previous 10 years.

10. I have a longstanding involvement with athletics and commitment to fitness. In addition to participating in team sports in college and running competitively in college and medical school, I have been an avid cyclist since I could ride a bike. In the early 1980's, I built my own racing bicycles and wheels (for time trials) and began using resistance trainers indoors. Over the past four decades, I have used a variety of indoor cycle trainers, from rollers to devices based on air, fluid, and magnetic braking and flywheel systems. I have also used a variety of electronic support devices, from cadence monitors to heart monitors, from commercial sources as well as my own design.

11. In 1999, I was certified as a Cycle Reebok Instructor and taught spinning classes at FitCorp in Boston. That year, I also received certifications as: Second Degree Black Belt, Tae Kwon Do, JH Kim TKD Institute, Boston; American College of Sports Medicine (ACSM) Health/Fitness Instructor; American Council on Exercise (ACE) Personal Trainer; ACE Clinical

Exercise Specialist; ACE Lifestyle & Weight Management; International Sports Science Association (ISSA) Specialist in Performance Nutrition; ISSA Fitness Trainer; and ISSA Specialist in Martial Arts Conditioning.

12. In addition to running several triathlons in the U.S., I placed 1st overall and in each category in the 2001 Seoul Triathlon. I have not owned or driven a car for two decades, and instead commute daily by bike.

13. My CV (attached at Exhibit A) lists all cases at which I testified as an expert witness at trial or by deposition during the last four years.

14. For my work on this case, I am being compensated $425 per hour. My compensation does not depend on the outcome of this suit.

## II. Scope of Work and Information Considered

15. Counsel for CycleOps has requested that I render opinions on whether the asserted claims of the ’865, ’015, ’964, and ’476 patents are valid and whether CycleOps infringes the’865, ’015, ’964, and ’476 patents.

16. Pursuant to the Court’s scheduling order in this case, this report covers questions related to the validity of the ’865, ’015, ’964, and ’476 patents. I anticipate that I will prepare a second report concerning the issue of whether CycleOps infringes the ’865, ’015, ’964, and ’476 patents after the plaintiff POWERbahn discloses its expert report on infringement.

17. In preparing my opinions in this report, I have reviewed and considered the following documents:

- The ’865, ’015, ’964, and ’476 patents and their prosecution histories;
- U.S. Provisional Patent Application No. 60/088,662;
- U.S. Provisional Patent Application No. 60/753,031;
- CycleOps’ Amended Invalidity Contentions, including all references cited therein;
- POWERbahn’s Infringement Contentions;
- CycleOps’s Amended Claim Constructions;

- POWERbahn's Proposed Claim Constructions
- Deposition of Scott Radow, taken September 7, 2017, with all deposition exhibits;
- Deposition of David Blau, taken October 3, 2017, with all deposition exhibits;
- All the prior art cited in this report; and
- All other documents cited in this report.

## III. Applicable Legal Standards and Principles

18. Although I am not an attorney, and I will not offer opinions regarding the law, I have been informed of certain principles of patent law that I have employed in arriving at my conclusions in this report.

19. The claims of a patent define, in words, the boundaries of the invention described and illustrated in the patent. Only the claims of the patent can be infringed. Neither the specification, which is the written description of the invention, nor the drawings, of a patent can be infringed. Each of the claims must be considered individually, and to show patent infringement, a plaintiff need only establish that one claim has been infringed.

20. There are two different types of patent claims. The first type is called an independent claim. An independent claim does not refer to any other claim of the patent. An independent claim is read separately to determine its scope. On the other hand, a dependent claim refers to at least one other claim in the patent and thus incorporates whatever that other claim says. Accordingly, to determine what a dependent claim covers, one must read both the dependent claim and the claim or claims to which it refers.

21. The terms used in patent claims should be given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention. However, I understand that courts may also construe claim terms to determine the scope and meaning of patent claims.

22. When a patent issues from the U.S. Patent and Trademark Office, the patent is entitled to a presumption of validity. I also understand that the presumption of validity can be overcome by clear and convincing evidence that the patent is not valid.

23. A patent claim is invalid for anticipation if a single prior art reference must disclose each and every element of the claim.

24. A claim is invalid as obvious if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. There are several rationales on which an obviousness determination may be based. For example, a claim is obvious if any of the following would lead a person of ordinary skill in the art to the claimed invention:

a) Combining one or more prior art references that individually do not disclose every element of the claim, but when combined, disclose each and every element of the claim, and the prior art references provided some teaching, suggestion or motivation to combine those references;

b) Combining elements according to known methods to yield predictable results;

c) Simple substitution of one known element for another to obtain predictable results;

d) Use of a known technique to improve similar devices, methods, or products in the same way;

e) Applying a known technique to a known device, method, or product ready for improvement to yield predictable results.

f) Obvious to try—choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success.

g) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art.

25. The validity of each claim must be separately evaluated. If one claim of a patent is invalidated, the remaining claims are not invalidated unless they are also anticipated or obvious in light of the prior art.

26. I understand that an invalidity analysis must be performed from the perspective of a person of ordinary skill in the art. The following criteria may be used to determine a person who would be considered one of ordinary skill in the art at the time the claimed invention was made: (1) educational level of the inventor; (2) the type of problems encountered in the art; (3) the prior art solutions to those problems; (4) the rapidity with which innovations are made; (5) the sophistication of the technology; and (6) the educational level of workers in the field.

27. I understand that POWERbahn has proposed that a person of ordinary skill in the art would have a bachelor's degree in mechanical or electrical engineering and an in-depth understanding of embedded firmware source code; or 5 years of experience designing electronic, programmable, exercise equipment. Although I agree with this so far as it goes, I would also include those with at least 5 years of experience in simulator design and development as persons of ordinary skill in the art. Some of the relevant prior art is in the field of video game simulators (e.g. U.S. Patent No. 5,240,417 identified in the '964 patent listing of prior art), and many cycling trainers are also fairly considered simulators.

28. Additional principles of patent law may be explained or alluded to as appropriate in other portions of my report.

## IV. Background of the Physics Underlying the Technology at Issue.

29. A basic understanding of physics may be helpful for understanding some of the general principles and mathematical equations underlying the technology in the patents-in-suit and in the prior art.

30. During Scott Radow's September 7, 2017 deposition testimony, he discusses Newtonian mechanics, even going so far as explaining that his basic invention is simply applying Newtonian mechanics to an exercise machine. Radow Dep. 160:11-17.

31. It thus may be helpful to have a basic understanding of the Newtonian mechanics, or Newton's "laws" of physics that describe the motion of items under the influence of a system of forces. Newton's laws of physics are fundamental principles taught in most introductory college physics classes.

32. Newton's First Law describes inertia: An object at rest tends to stay at rest; an object in motion tends to continue in motion at constant speed and in a straight line. Stated another way, Newton's first law says that an object remains in motion unless acted on by a force. The patents-in-suit discuss the concepts of both inertia and momentum. Inertia is the resistance to changes in motion. Momentum is simply mass in motion, and is defined as mass times velocity.

33. Newton's Second Law relates to the relationship between force, mass, and acceleration. Stated simply, the second law is that force equals mass times acceleration. Acceleration is the rate of change of the velocity of an object with respect to time. The only way to change an object's motion is to use force.

34. Newton's Third Law is that for every action, there is an equal and opposite reaction. Consider a bicycle as an example, where a person is riding a bicycle on a road with a constant acceleration. To do this, the bicycle has to exert a force against the road, otherwise the bike would not be accelerating. Additionally, the road has to exert the same force back on the bike. There are two forces involved.

35. A concept related to force is the concept of "torque." Torque is rotational force. Torque is also sometimes called "moment," or "moment of force." Force itself is linear as discussed in Newton's Second Law—but torque (rotational force) is not. Torque is the twisting of an object. The magnitude of torque depends on the force applied, the length of the lever arm, and the angle between the force vector and the lever arm. For example, when a cyclist pedals a bicycle, she pushes on the pedals (applying a force), this force operates on the cranks of the bicycle (the "arms" attached to the pedals) to apply a torque to the crankset of the bicycle to drive the chain of the bicycle. Just as there is linear inertia, there is also rotational inertia, which is essentially the resistance to rotational acceleration.

36. The patents-in-suit also use the term "haptic equation." The term "haptic" itself is extremely broad. Dictionary definitions of the term "haptic" generally refer to the sense of touch. For example, "haptic" is defined by the online Merriam-Webster dictionary as: "1) relating to or based on the sense of touch; and 2) characterized by a predilection for the sense of touch (a haptic person)."[1] The online Oxford dictionary defines "haptic" as: "relating to the sense of touch, in particular relating to the perception and manipulation of objects using the senses of touch and proprioception. 'haptic feedback devices create the illusion of substance and force within the virtual world'"[2] In the context of physics, haptics also relates to force because of Newton's laws discussed above. Usually in haptics, there is some type of force feedback, but that concept is also a broad one. Force feedback could be very specific in the context of using haptics in video game controllers, or could be very broad in the sense of describing a basic characteristic of operation of a device.

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1 https://www.merriam-webster.com/dictionary/haptic

2 https://en.oxforddictionaries.com/definition/haptic

37. Flywheels will also be discussed in this case. A flywheel is a heavy revolving wheel that stores rotational energy. Flywheels resist changes in rotational speed by their moment of inertia. In other words, the amount of energy stored in a flywheel is proportional to the square of its rotational speed. Flywheels are used to smooth the power output of an energy source, or to dampen fluctuations in energy. Flywheels have also been used for decades in bicycle trainers and other exercise devices to provide a simulation of momentum or inertia. *See, e.g.* U.S. Patent No. 5,256,115 at 1:14-45. A flywheel will have both a momentum and an inertia, which are related: flywheels that are harder to move, or whose momentum is harder to change, have more inertia.

38. In addition to these basic principles of physics and exercise physiology, there are well established fields of study that related to virtual reality and augmented reality. Virtual reality is the use of computers to immerse the user in a multimedia environment that's rich enough in synthetic cues to make the simulated environment seem real. And augmented reality is a view of a real-world environment or situation that is supplemented or "augmented" by the combination of real world and computer generated data.

39. Against this backdrop, I turn next to a discussion of the teachings of the patents-in-suit.

## V. The Patents-in-Suit

### A. The '865, '015, and '964 Patents

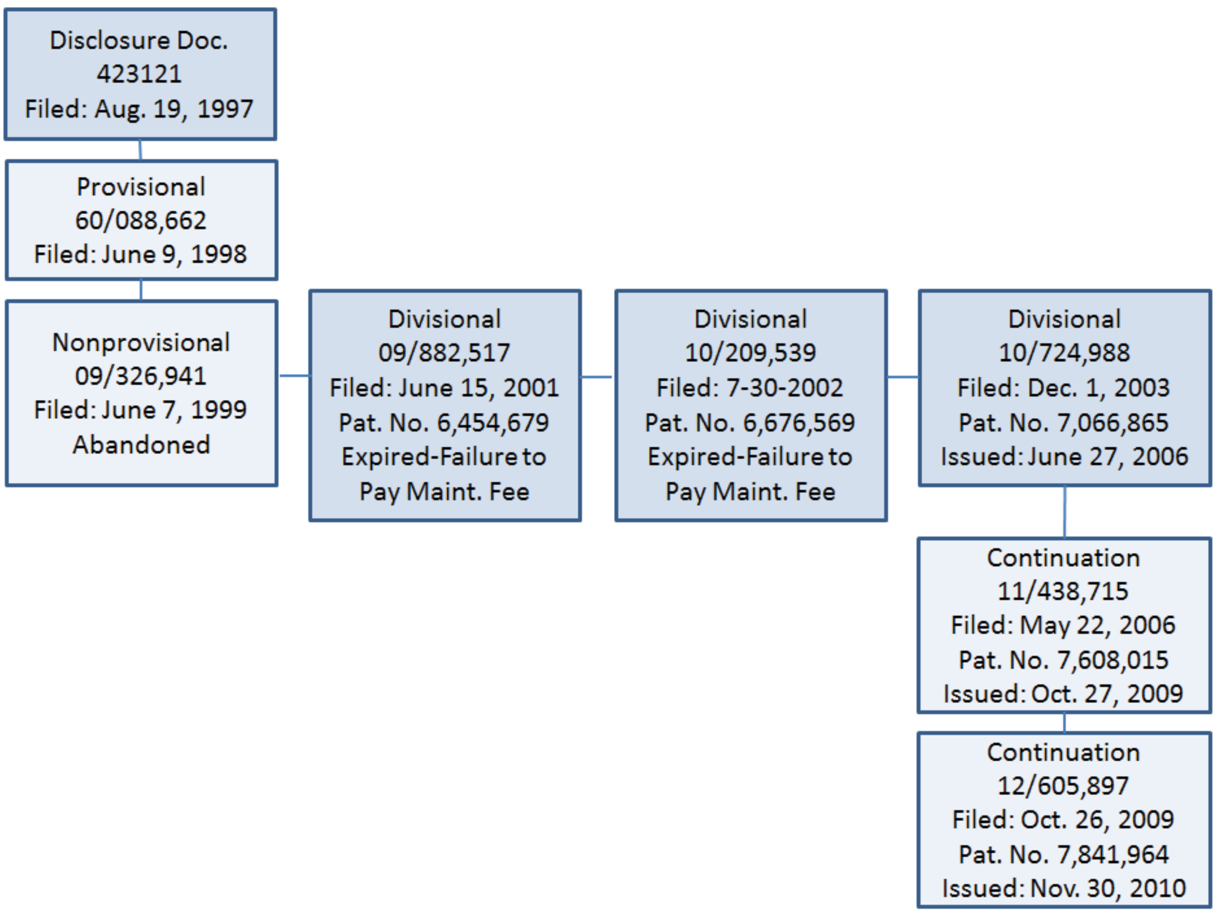
40. I understand that POWERbahn is asserting that the following claims of the '865, '015, and '964 patents are infringed: claims 16, 18, 20, 21, and 24 of the '865 patent; claims 1, 2, 4, 9, and 10 of the '015 patent; and claims 1-7 of the '964 patent.

41. The '865, '015, and '964 patents claim apparatuses and methods for simulating physical activity. I have reviewed the '865, '015, and '964 patents and their prosecution histories. Counsel has informed me that the '964 patent is a continuation of the '015 patent,

which itself is a continuation of the ’865 patent, and that the three patents share the same underlying disclosure. I understand that the ’865, ’015, and ’964 patents share the same specification. Thus, any discussion or citation to any one of those specifications applies equally to all of the asserted claims of the’865, ’015, and ’964 patents.

42. Scott Radow is listed as the sole inventor on the ’865, ’015, and ’964 patents.

43. Below is a chart of the relationship between the ’865, ’015, and ’964 patents and the applications to which they claim priority:




**1. Overview of the Disclosure in the ’865, ’015, and ’964 Patents.**

44. The ’865, ’015, and ’964 patents relate to exercise devices for “bipedal locomotion,” a term that the specification uses to mean moving on two legs in an upright

position, *e.g.*, walking or running. In fact, the title of the ’865 patent, which was filed before the ’015 or ’964 patents, is “Bipedal locomotion training and performance evaluation device and method.” The ’865, ’015, and ’964 patents disclose several embodiments, shown in Figs. 1A-1M, all of which involve the user moving on two legs in an upright position. For example, Fig. 1A illustrates a preferred embodiment of the exercise apparatus:

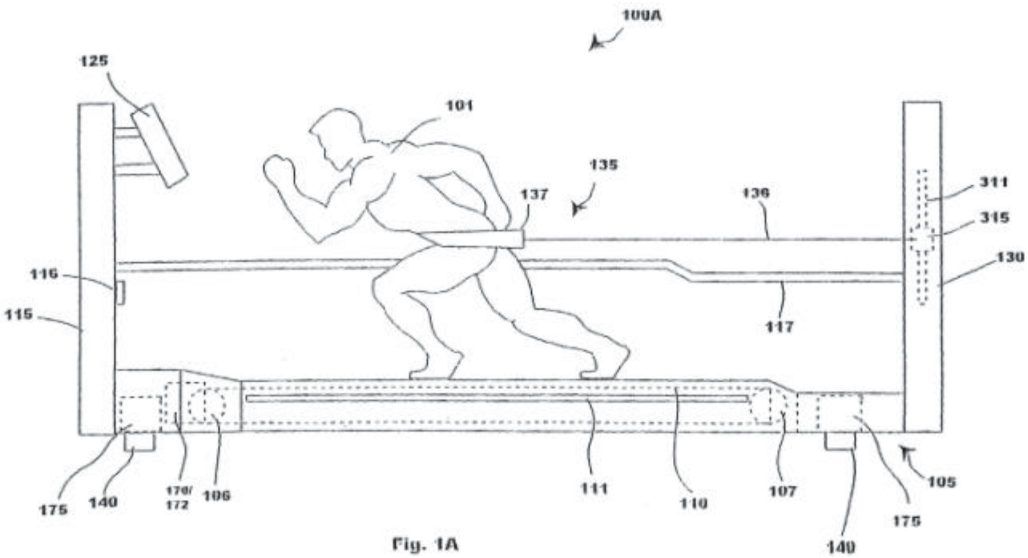



Fig. 1A

45. As the specification describes, “[t]he present invention is directed to a physical training and performance evaluation method and apparatus,” where the “apparatus includes a revolving belt on which a subject may perform bipedal locomotion, and one or more harnesses for supporting the subject, and/or fixing the position of the subject, and/or monitoring the forces exerted by the subject.” ’865 patent, 17:55-50. The specification says that the present invention is an apparatus for bipedal locomotion—as are all disclosed embodiments. The apparatus includes (1) a revolving belt on which the user walks or runs and (2) “one or more harnesses” attached to the user. ’865 patent, 17:55-50.

46. The “one or more harness,” as described by the specification, both secures the user at a fixed position and measures the force applied by the user. *E.g.* ’865 patent, Abstract. It

is this second function of the harness—to measure the user applied force—that the specification describes as necessary for the simulation of "real-world or virtual-world environments." '865 patent, 48:6-11. For example, the specification states that the more closely the user applied force is measured, "the more realistic is the simulation of the apparatus to the circumstance being simulated." '865 patent, 48:56-59.

47. The devices discussed in the patents simulate physical activity by calculating a "virtual velocity" of the treadmill belt or other moveable part of the device, comparing it to the actual measured velocity, and then adjusting the brake or resistance force to so that the measured velocity equals the "virtual velocity." All of the equations in the specification that calculate the "virtual velocity" require as an input at least one user applied force as measured by a force sensor—that is, calculating the "virtual velocity" requires first measuring how much force the user applies to the device. This method, the specification says, allows the exercise devices to be responsive to the user's movement and forces. '865 patent, 48:6-18.

48. The specification interchangeably calls the "virtual velocity" a target velocity, update velocity, $V_{update}$, or $V_{set}$ in the specification. It discloses modes of operation and corresponding mathematical equations that can be used to calculate a "virtual velocity." *See* '865 patent, Figs. 2A& 2B. The specification teaches that four of those nine modes of operation (those in Fig. 2A) are "haptic modes" that "simulate real-world or virtual-world environments." '865 patent, 32:17-20 & 33:20-27. To calculate the disclosed "virtual velocity" or $V_{update}$, the specification starts with general and basic physics equations and then applies them to different uses in a straightforward manner. The specification, including Figs. 2A & 2B, describe how the equations rely on a number of different variables, which the specification separates by class. The "input variables" are fixed variables like the weight or height of the user. '865 patent, 33:49-

34:8. The "calculated variables" are calculated from the input variables. '865 patent, 34:9-28. The "measured data," as the specification says, "is data obtained from sensors, such as the fore force obtained from the fore force sensor [or] the aft force obtained from the aft force sensor …." '865 patent, 34:29-40.

49. Every single "$V_{Update}$" equation described in the specification has at least one user applied force among the "measured data"—that is, the specification teaches that all of the disclosed applications require measuring at least one user applied force with a force sensor. '865 patent, Figs. 2A & 2B; 34:29-40.

50. None of the disclosed modes of operation in Figs. 2A & 2B, or indeed anywhere else in the specification, involve an exercise bike. Where the specification does discuss exercise bikes, it says they are deficient. The specification says that "[c]urrently-available exercise bikes have a number of deficiencies with regards to the training of athletes for bipedal locomotion." '865 patent, 10:1-3. According to the specification, one deficiency is that exercise bikes "provide[] no means of immovably securing the subject while forces are applied to the pedals." '865 patent, 10:8-10. Because the user of an exercise bike is not "immovably secured" to the bike, "the unmonitored motions of the body of the bicyclist result in an uncertainty in the magnitude of the applied forces by the subject, even if the forces on the pedals were to be precisely monitored." Thus, the specification says that exercise bikes are deficient in their ability to accurately measure the user applied force, while providing no way to cure that deficiency.

51. Accurately measuring the user applied force is a crucial feature of the specification. The specification states: "It should be noted that the more frequently the actual force F is monitored, the more realistic is the simulation of the apparatus to the circumstance being simulated." '865 patent, 48:56-58; *see also* 57:3-5 (describing the "accuracy with which

force and velocity may be monitored with the apparatus and method of the present invention"); 57: 55-58 (saying the "present specification describes" accomplishing the following function: "the forces exerted by the subject …can be accurately monitored"). Conversely, the specification teaches, if the user's position is not immovably secured—as with an exercise bike—then the user's applied force is not accurately measured and the disclosed equations "are only approximately correct or do not hold." '865 patent, 31:45-48.

### 2. Priority Date of the Asserted Claims of the '865, '015, and '964 Patents

52. The '865, '015, and '964 patents claim priority to a provisional application, No. 60/088,662, filed on June 9, 1998. The '662 provisional application has a different disclosure than the '865, '015, and '964 patents. '662 provisional application, SARIS018045. The disclosure of the '865, '015, and '964 patents was not submitted until June 7, 1999, the filing date of the first non-provisional application in this patent family, U.S.S.N. 09/326,941, which was abandoned and never issued as a patent.

53. I understand that the claims of the '865, '015, and '964 patents are only entitled to a priority date of June 9, 1998—*i.e.*, the filing date of the '662 provisional application—if the disclosure of the'662 provisional application provides written-description support for the asserted claims. I understand that an adequate written description requires that the disclosure convey with reasonable clarity to those skilled in the art that, as of the filing date sought, that the inventor was in possession of the claimed subject matter. I understand that a disclosure may show possession of the claimed subject matter by using such descriptive means as words, structures, figures, diagrams, and formulas that fully set forth the claimed invention and that the claimed subject matter need not be described literally to satisfy the written-description requirement

54. I do not believe that the disclosure of the'662 provisional application provides adequate written description support for any of the asserted claims, at least because the disclosure of the '662 provisional application fails to provide any express, implicit, or inherent support for the following claim limitations: "haptic equation incorporating an equation of motion" in the '865 patent; "simulate the effects of changes in momentum," "determining an equation of motion for a physical activity involving human motion," "wherein the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity," and "control parameter determined at least in part by the value of the variable and the equation of motion for the physical activity being simulated by the apparatus" in the '015 patent; and "simulate the effects of changes in momentum," "determining a virtual velocity of the physical activity being simulated," "the estimate of a target velocity comprises an estimate of a velocity that would occur during the physical activity being simulated if the applied force had been applied by a user during an actual physical activity," "comparing the actual velocity of the virtual velocity," and "controlling at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on the comparison of the actual velocity to the virtual velocity" in the '964 patent.

55. The disclosure of the '662 application is substantially different than the shared specification of the '865, '015, and '964 patents. There are a few common paragraphs in the Background of the Invention, which mostly relate to general principles of exercise, but otherwise the disclosure of the '662 application is almost entirely different than the shared specification of the '865, '015, and '964 patents. The disclosure of the '662 application, for example, never even uses the term "haptic equation," a limitation found in all asserted claims of the '865 patent.

Neither does the disclosure of the ’662 describe, even implicitly, any other “equation of motion,” a limitation of all the asserted claims of the ’015 patent. Finally, the disclosure of the ’662 application never describes a “virtual velocity” as that limitation is used in all of the asserted claims of the ’964 patent. The disclosure of the ’662 application does describe a “target velocity” or “$V_{set}$”, but the ’662 application describes this as a ***pre-set*** value that is “selected by the trainer or user at the control panel.” ’662 application, p. 25, SARIS018071. This “target velocity” or “$V_{set}$” is, therefore, substantially different than the “virtual velocity” claimed by the ’964 patent, which is a ***time-varying*** “estimate of a velocity that would occur during the physical activity being simulated if the applied force had been applied by a user during an actual physical activity.” ’964 patent, claim 1. Accordingly, for at least these reasons, it is my opinion that none of the asserted claims of the’865, ’015, and ’964 patents are entitled to a priority date of June 9, 1998. Instead, it my opinion that the asserted claims of the’865, ’015, and ’964 patents, to the extent they have written-description support at all, are entitled to a priority date of no earlier than June 7, 1999, the filing date of the first nonprovisional application in the patent family. See ¶ 43.

56. Nonetheless, my opinion that the asserted claims of the ’865, ’015, and ’964 patents are invalid does not depend on whether they are entitled to a priority date of June 9, 1998 or June 7, 1999. It is my opinion that all of the asserted claims are invalid, for the reasons described below, regardless of whether the claims are entitled to a priority date of June 9, 1998 or June 7, 1999.

**B. The ’476 Patent**

57. I understand that POWERbahn is asserting that the following claims of the ’476 patent are infringed: claims 1-3, 6, 8, 9, 17-19, and 28.

58. The ’476 patent, entitled “EXERCISE DEVICE,” claims exercise devices for simulating a human physical activity and stationary exercise bikes. I have reviewed the ’476

patent and its prosecution history. The ’476 patent issued from U.S.S.N. 11/644,777, which was filed on December 22, 2005. The ’476 patent claims priority to provisional application, No. 60/753,031, filed on December 22, 2005.

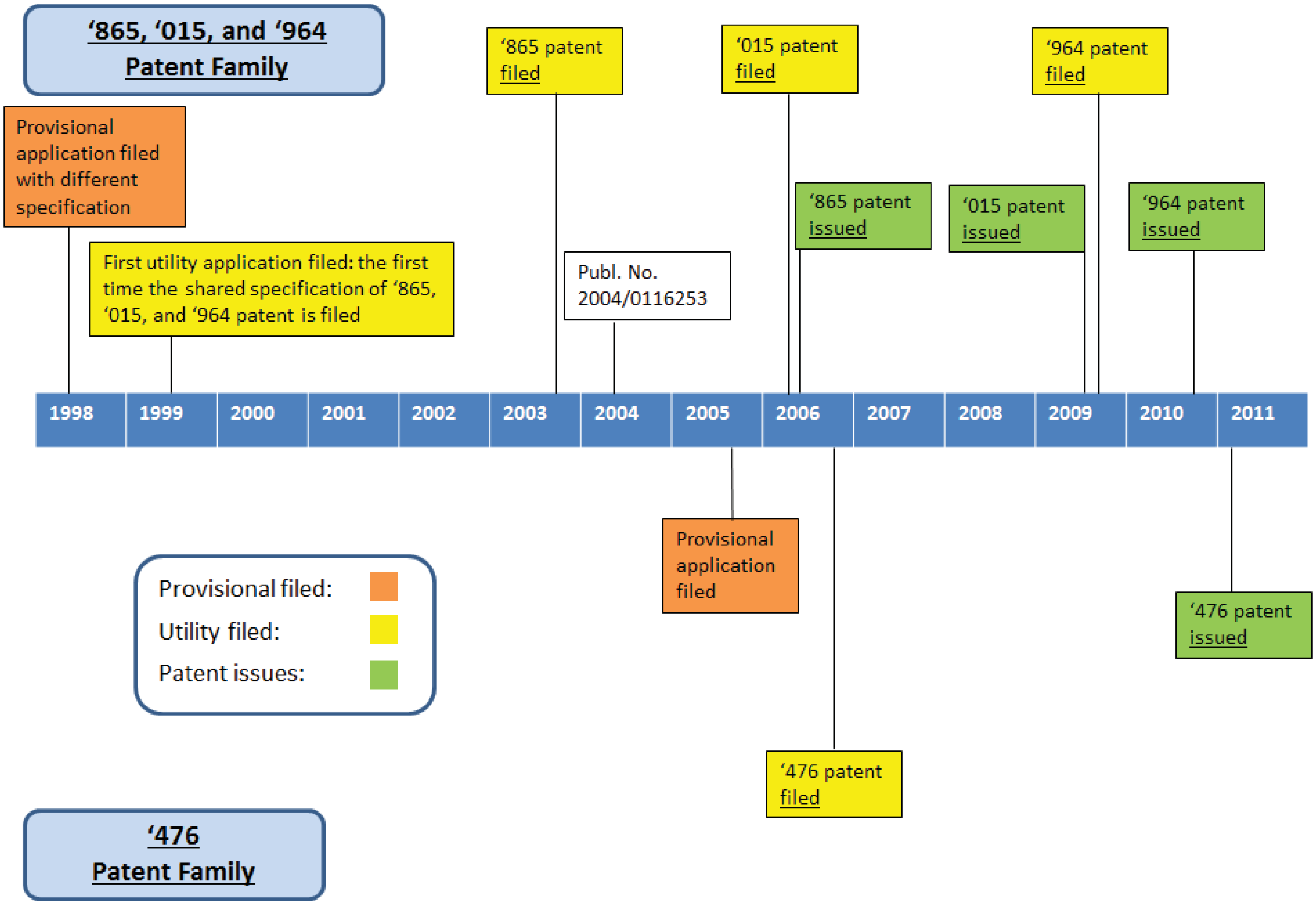
59. Scott Radow and David Blau are listed as inventors.

60. The ’476 patent does not claim priority to any application from the same patent family as the ’865, ’015, or ’964 patents, which list Scott Radow as sole inventor.

**1. Overview of the Disclosure of the ’476 Patent.**

61. As shown in the timeline below, the ’476 patent has a later priority date than the ’476, ’015, and ’964 patents. The ’476 patent claims priority to no earlier than December 22, 2005, whereas the shared specification of the’476, ’015, and ’964 patents was filed on June 7,

1999 and published as U.S. Patent Publ. No. 2004/011625 on June 17, 2004.




62. While the '476 patent discloses subject matter in its specification that had not previously been disclosed by the '865, '015, and '964 patents, the asserted claims of the '476 patent only recite subject matter already disclosed by the '865, '015, and '964 patents. I describe in detail (below at § XI) why the asserted claims of the '476 patent are anticipated on that basis. As illustrated by claim 1 below, the asserted claims of the '476 patent recite an "exercise device" (not exercise bike or trainer) that compares an actual velocity to a calculated "virtual" velocity and, based on that comparison, controls the resistance force to the user:

> 1. An exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass

> under an influence of a force generated by a human in performing the activity, the exercise device comprising:
>
> a structural support;
>
> a user input member movably connected to the structural support for movement relative to the structural support to define a measured velocity that is measured during application of an input force to the input member by a user, and wherein the user input member defines a variable resistance force tending to resist movement due to input force applied by a user;
>
> a control system that utilizes a velocity difference between the measured velocity and a virtual velocity as a control input to control the resistance force on the user input member, wherein the control system is configured to continuously and rapidly recalculate the virtual velocity while an input force is being applied to the input member by a user, and wherein the control system is configured to determine the virtual velocity, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force for the human physical activity being simulated and wherein the control system is configured to continuously and rapidly recalculate the velocity difference while an input force is being applied to the input member by a user such that the resistance force varies to simulate the changes in force experienced by a user due to changes in momentum of the human physical activity that is being simulated.

63. This general method of simulating physical activity had already been disclosed to the public by U.S. Patent Publ. No. 2004/0116253, which was published on June 17, 2004. This is the public disclosure of Application Serial No. 10/724,988, which later issued as the ’865 patent.

64. Though not in any of the asserted claims, the specification of the ’476 patent does disclose features that are not found in the ’865, ’015, and ’964 patents. The ’476 patent, for example, does actually describe exercise bikes as part of the disclosed subject matter. None of the asserted claims of the ’476 patent, however, are limited to exercise bikes. Instead, all cover “exercise device[s]” more broadly. As a second example, the ’476 patent describes an alternator control circuit that is not found in Mr. Radow’s other patent family. ’476 patent, Figs. 20-25; 19:64-23:16. Once again, none of the asserted claims are directed to the alternator control

circuit. As a third example, the ’476 patent describes estimating the user applied force *without* force sensors, ’476 patent, 10:31-57, whereas the ’865, ’015, and ’964 patents require directly measuring the user applied force with force sensors, ’865 patent, 48:6-11. None of the asserted claims of the ’476 patent recite this feature, however.

#### 2. Priority Date of the Asserted Claims of the ’476 Patent

65. The ’476 patent claims priority to a provisional application, No. 60/753,031, filed on December 22, 2005. The ’031 provisional application has a different disclosure than the ’476 patent. The specification of the ’476 patent was not submitted until December 22, 2006, the filing date of the ’476 patent.

66. My opinion that the asserted claims of the ’476 patent are invalid does not depend on whether they are entitled to a priority date of December 22, 2005 or December 22, 2006. It is my opinion that all of the asserted claims are invalid, for the reasons described below, regardless of whether the claims are entitled to a priority date of December 22, 2005 or December 22, 2006.

### C. Claim Construction

67. I have reviewed the claims constructions proposed by both parties, which I attach as Exhibits B & C. It is my opinion that the asserted claims of the ’865, ’015, ’964, and ’476 patents are invalid under either party’s proposed claim constructions. Specifically, the claim constructions proposed by CycleOps, which I agree with, are consistently of narrower scope than the claim constructions proposed by POWERbahn, which I do not agree with. For the purposes of this report, I will use the claim constructions proposed by CycleOps, unless otherwise noted. In general, if the prior art would have invalidated the asserted claims under CycleOps’ narrower constructions, then so too would the asserted claims be invalid under POWERbahn’s broader constructions.

**VI. State of the Relevant Art in the Late 1990s.**

68. A bit of background in the "state of the art" may be helpful to understand the knowledge that was available to person of ordinary skill in the art as of the priority date of the patents-in-suit. There was a rich body of prior art from which inventors in this field could draw from. By 1998, there were many different exercise devices that provided a simulation of a physical activity, including bicycling, running, and climbing stairs, among others. Most individuals who are old enough to remember the timeframe will know that any fitness or workout facility in the mid or late 1990s would have had treadmills, stationary bicycles, rowing machines, and other exercise machines. An age old problem, and something that would have motivated a person of ordinary skill, is for exercise machines to provide ever more realistic simulations.

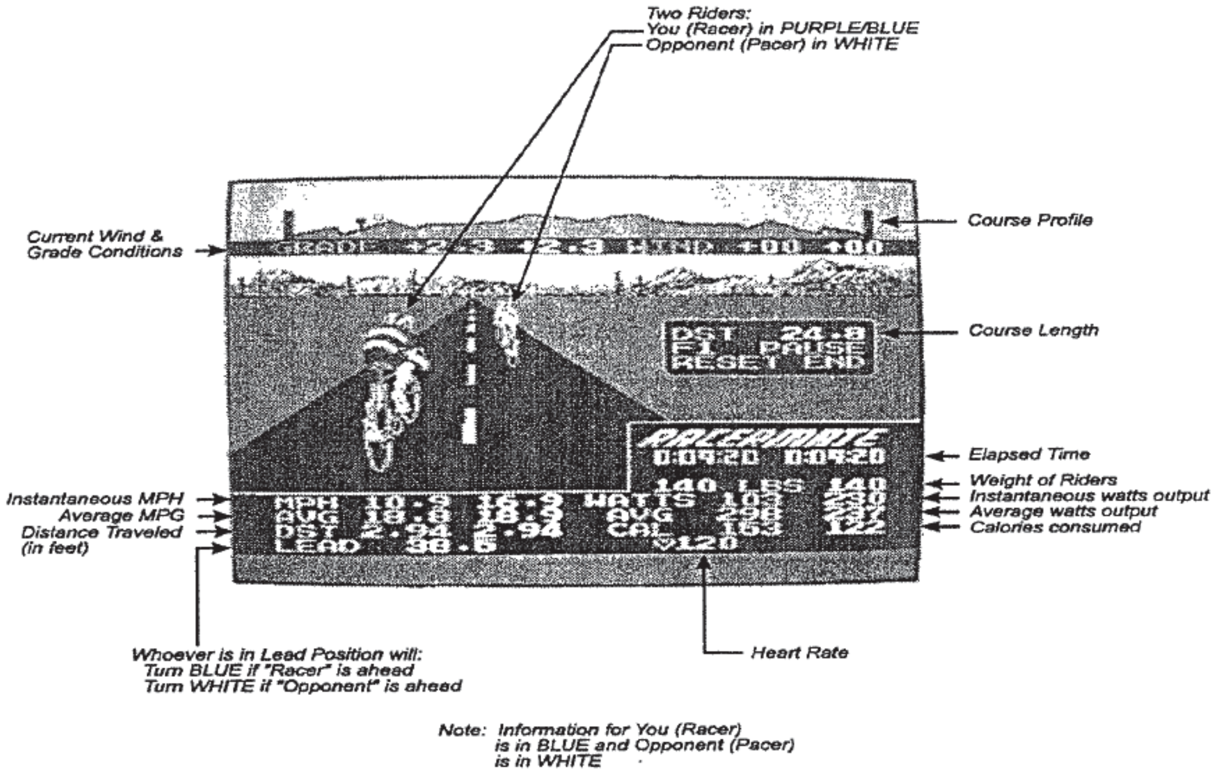
69. The patent and published prior art confirms this. By 1990, or at least the early 1990s, many exercise devices provided simulations of exercise and used various types of controls to do so: for example, treadmills (see, e.g., U.S. Patent No. 5,176,597); stair climbers (see, e.g., U.S. Patent No. 4,938,474), stationary exercise bikes (see, e.g, U.S. Patent No. 4,786,049), and even video game-style bike and motorcycle racing simulators (see, e.g., U.S. Patent No. 5,364,271).

70. Even outside of traditional "exercise" equipment, it was known in the prior art to the patents-in-suit to use control systems for other types of "ergometers," or machines for measuring and simulating work. One article published in 1990 describes a wheelchair ergometer "in which a combination of realistic simulation of wheelchair propulsion—with adjustable parameters for rolling resistance, air drag, wind speed and slope—and force measurement." *See* Ruud Niesing et al., *Computer-Controlled Wheelchair Ergometer*, 28 Med. & Biol. Eng'g & Comput. 329 (1990). This publication demonstrates that the forces controlling propulsion of the

wheelchair were known and understood by 1990, along with the basic equations of motion. The publication also describes on pages 330-331 how to implement these equations to calculate the relevant forces and "create a realistic simulation of wheelchair propulsion under varying conditions." *Id.* at 331.

71. With respect to outdoor cycling specifically, by the mid-1990s, many different types of devices existed that provided fairly realistic simulations of outdoor training. Some of these were relatively simple mechanical devices, such as rollers, on which a bicycle was placed. Other devices—and their control systems—were more sophisticated and allowed a cyclist to obtain reasonably accurate data feedback or simulations, such as riding a particular race course or simulating a race against others. *See e.g.*, U.S. Patent Nos. 4,898,379, 4,938,475, U.S. Patent No. 5,089,960, and U.S. Patent No. 5,656,001; *see also* SARIS016089 (June 1991 Cycling Science excerpt providing overview of Nashbar, Slocum, Schwinn, Racermate, and Balboa trainer products).

72. For example, consider RacerMate's CompuTrainer product, which I understand was sold in several versions over the years. For example, the RacerMate CompuTrainer Model CAT 8000 ("CompuTrainer") was sold as early as 1994 and allowed the user to race against other riders on a completely custom course that could simulate inclines, wind, miles, and even drafting another rider. SARIS018014. The image below was taken from a 1994 Operating Manual for the CompuTrainer, and shows the main display screen for simulating a race:




### *Custom Courses*

Allows the user to create custom courses to their own specifications within the following parameters:

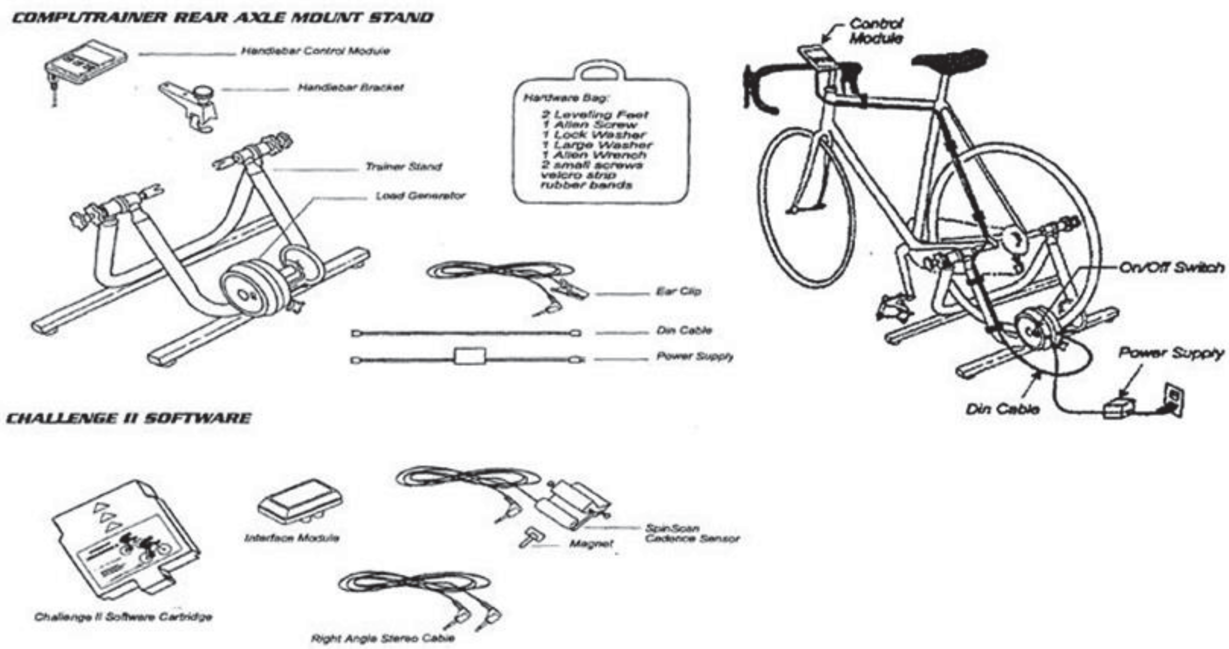
| | |
|---|---|
| Grade | +/- 9.9% |
| Wind | +/- 99 mph |
| Miles | 0.1 to 99.9 |
| Course Legs | 20 |

73. The CompuTrainer used a number of well-known parts and steps, as shown below:

**The CompuTrainer consists of:**

1) a stable, rear-axle mount **Trainer Stand** that supports the bike,
2) a proprietary **Load Generator** driven by the rear tire,
3) a microprocessor based **Handlebar Control Module** which controls the **Load Generator**.
4) a **Cadence Sensor** to operate SpinScan, and
5) an **Earclip Heart Rate Sensor.**

By measuring your speed together with the load factors encountered on the various courses, the **Load Generator** will create the appropriate resistance. In the stand-alone mode all changes to the load generator are controlled from the **Handlebar Control Module.**




74. The CompuTrainer, like most exercise devices, selected its components from a common set of well-understood and predictable elements. First, exercise devices needed a base to support the user. The CompuTrainer used a trainer stand that stabilized the user's bike. A stationary exercise bike would include a base and frame on which the user could sit. A treadmill would use a stable base on which the user could stand, run, and walk.

75. Second, exercise devices needed some moveable part that would move in response to a user applied force. The CompuTrainer, for example, had bike pedals that the user pushed against and caused to move. So would have a stationary exercise bike. Similarly, a treadmill would have a belt that turns when the user walks or runs on top of it.

76. Third, exercise devices needed some type of force to resist the user's movements. If an exercise bike or treadmill offered no resistance to the user, it would not be effective or worthwhile—the pedals of the exercise bike or the belt of the treadmill would merely spin without resistance. There were a number of common means to apply a resistance force, including a DC motor, generator, alternator, and magnetic brake systems. One commonly used type of magnetic brake was called an eddy current brake. *See, e.g.*, U.S. Patent No. 4,898,379, 7:26-38 & 8:62-9:28; U.S. Patent No. 4,786,049, Figs. 1 & 2; U.S. Patent No. 5,656,001, Abstract, claim 1, & Figs. 1-4.

77. Fourth, exercise devices often had sensors to measure certain characteristics of the simulated exercise. The CompuTrainer, for example, had a cadence sensor that measured the revolutions per minute of the pedals. Velocity sensors in general were very common and well-known means to precisely measure how fast the moveable part (*e.g.*, the pedals or treadmill belt) were actually moving in response to the user's force, as shown by the following representative teachings in the prior art: U.S. Patent No. 4,785,674, claim 11 & Figs. 1-3; U.S. Patent No. 4,786,049, Figs. 1 & 2; U.S. Patent No. 5,015,926, Abstract, claim 1, & 6:34-54; U.S. Patent No.5,364,271, 7:9-20 & 16:34-64; U.S. Patent No. 5,785,630, 12:11-53, Figs. 2A, 4-5B, & 21. Similarly, force sensors were a common and well-known means to directly measure the actual force the user was exerting. *See, e.g.*, U.S. Patent No. 4,785,674; U.S. Patent No. 5,015,926, Abstract, claim 1, & 6:34-5; *see also* SARIS017659 (VR Bike Maintenance and Repair Manual from October 1997 at 4, and explained throughout).

78. Fourth, exercise devices often had a computer, which could control the resistance supplied by the brake or motor in response from inputs from the sensors. A computer allowed for constant and continuous adjustments of the resistance in response to the data from the

sensors, providing better and more realistic simulations. One common sense and predictable way to control the resistance was based on a comparison of the actual speed, as measured by a speed sensor, to some "target," or desired speed. The "target" speed could either be set by the user or dynamically calculated by the computer in response to data from one or more sensor. The resistance would then vary in a way that forces the actual speed of the exercise device to match the "target" speed—*i.e.*, if the actual speed is greater than the "target" speed, then the resistance increases; and if the actual speed is less than the "target" speed; than the resistance decreases. As one example, claim 1 of U.S. Patent No. 5,919,115 discloses a method where the resistance forces the actual speed to equal a "target" speed:

> 1. A method of providing a resistance force to a user of an exercise machine which includes a member which is movable along a path and which is configured to engage a part of the user's body to execute an exercise motion in which the member has a position and a velocity, comprising:
>
> > sensing the position and the velocity of the member during the exercise motion,
> >
> > determining a user force exerted by the user along the path from a parameterized function of the position and the velocity,
> >
> > determining a velocity profile as a varying function of the position, and
> >
> > providing the resistance force in a manner to cause the velocity to follow the velocity profile.

79. Accordingly, there was an established toolbox of elements that a person of ordinary skill would have used for exercise devices. Each of those elements was well-known and would provide predictable results to one of ordinary skill in the art.

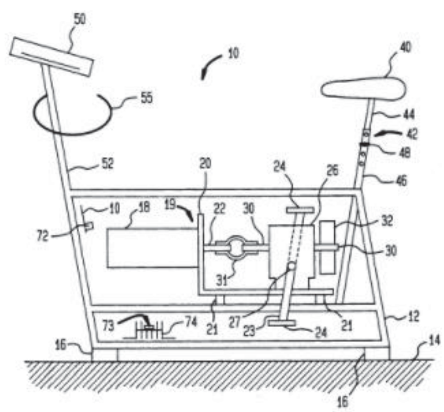
## VII. U.S. Patent No. 5,256,115 Anticipates or Renders Obvious the Asserted Claims

80. The '115 patent issued on October 26, 1993, which is more than one year before the priority date of the '865, '015, and '964 patents (regardless of whether those are entitled to a priority date of June 9, 1998 or June 7, 1999) and more than one year before the priority date of

the ’476 patent. Accordingly, the ’115 patent is prior art to the ’865, ’015, and ’964 patents and to the ’476 patent.

81. The ’115 patent is directed to “an exercise apparatus; and more particularly, to a stationary exercise bicycle which electronically provides an adjustable load torque to control the intensity of an exercise session.” ’115 patent, Abstract. Figure 1 illustrates an embodiment of the ’115 patent:

FIG. 1



82. The “heart” of the ’115 patent is a “speed reference” signal, which is a calculated, or virtual, velocity that simulates the action of a large physical flywheel. ’115 patent, 8:1-8 & 45-53. The “speed reference” signal is calculated according to the following equation, *see* ’115 patent, 8:46-46 & 2:25-35:

$S=\int(T_p - T_1)/J$
where
S is the speed reference signal;
$T_p$ is an input torque signal;
$T_1$ is a preset load torque signal;
J is a selected value which corresponds to an inertia

83. In that equation, the input torque signal, $T_p$, represents the rotational force applied by the user to the exercise machine. Torque is the rotational force resulting from the user applied

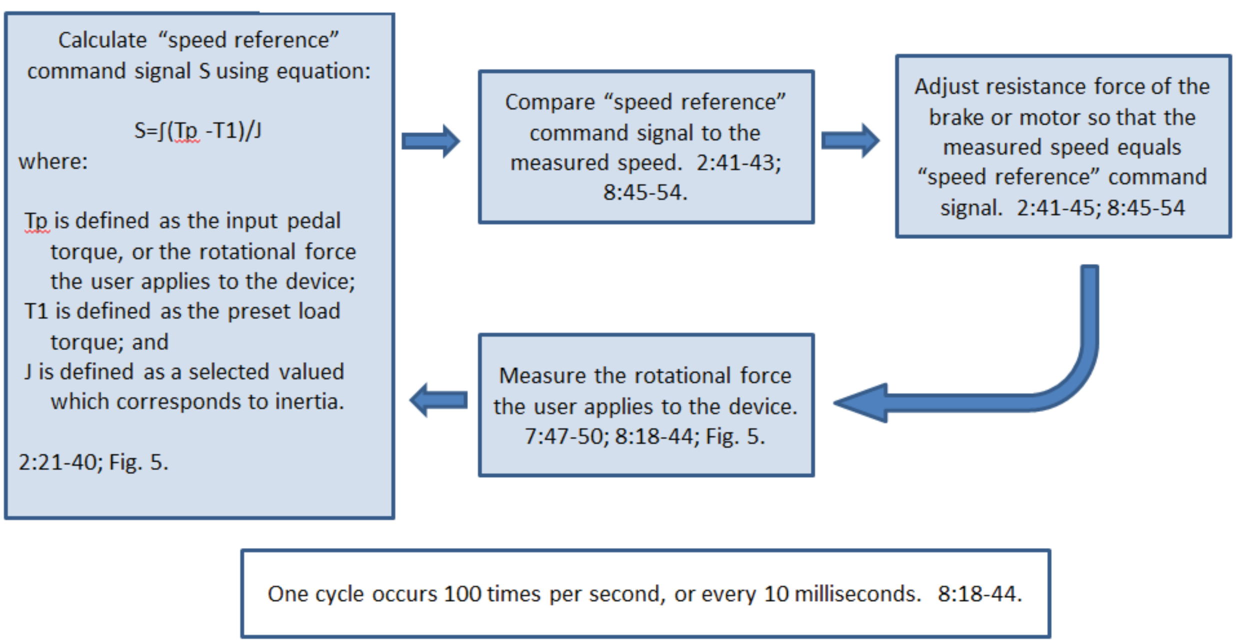
force relative to the suspension point (i.e., 27 in figure 1, above). The ’115 patent discloses a means to directly measure the input torque. ’115 patent, 6:20-21.

84. The “load torque,” or $T_1$, represents the resistance force supplied by a brake or motor that opposes the user’s actions. ’115 patent, 1:22-23; 2:6-9.

85. After calculating the “speed reference” signal, the ’115 patent compares that calculated velocity to the actual velocity, which it calls the “input speed.” ’115 patent, 2:41-45. The ’115 patent discloses measuring the input speed a number of different ways, including by using a sensor like a tachometer (which measures rotational speed such as “rpms” or revolutions per minute). ’115 patent, 2:43-47. The device in the ’115 patent then adjusts the load torque—*i.e.*, the resistance force supplied by a brake or motor—to force the measured “input speed” to equal the calculated “speed reference” signal.

86. The method taught by the ’115 patent is diagrammed below:

**How the ’115 Patent Simulates Physical Activity**



87. The method and apparatus taught by the ’115 patent allow for the simulation of real-world physical activity. The ’115 patent even teaches that the “speed reference” equation can be used to “simulate[] tours over hills.” ’115 patent, 9:62-65; *see also* claim 5 (“The stationary exercise bicycle in accordance with claim 3 wherein said preset load torque comprises a varying series of simulated tours over hills.”).

### A. The ’115 Patent Anticipates or Renders Obvious Independent Claim 16 of the ’865 Patent

88. It is my opinion that the ’115 patent anticipates claim 16 of the ’865 patent, the only asserted independent claim of the ’865 patent. Claim 16 recites:

> 16. An apparatus for simulating forces and movement of a human subject during a physical activity, comprising:
>
> a base;
>
> a movable member mounted to the base, the movable member defining a velocity and receiving an input force applied to the movable member by a human subject;
>
> a force-generating device operably coupled to the movable member and applying a resistance force to the movable member;
>
> a sensor configured to provide a signal corresponding to at least one of the velocity of the movable member and an input force applied to the movable member by a human subject; and
>
> a controller configured to control the resistance force applied to the movable member by the force-generating device based, at least in part, on a signal provided by the sensor and a haptic equation incorporating an equation of motion of a human subject performing the physical activity being simulated.

89. The ’115 patent expressly discloses each limitation of this claim.

90. The ’115 patent discloses an apparatus for simulating forces and movement of a human subject during a physical activity. The ’115 patent teaches “an exercise apparatus … which electronically provides an adjustable load torque to control the intensity of an exercise session.” ’115 patent, 1:8-11; *see also* 4:39-40 (“The apparatus of the present invention is useful as an exercising apparatus”). In my opinion, and for reasons I more fully explain in my expert

report on non-infringement, the claim term "simulating forces and movement of a human subject during a physical activity" should be construed as "making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass." The exercise apparatus of the '115 patent meets this definition. As discussed below, the exercise apparatus of the '115 patent calculates a velocity that simulates the speed of a flywheel based on the input torque, or the rotational force applied by the user, as measured by a force sensor. *E.g.* '115 patent, 2:14-43; 6:21-25; 8:62-65. The exercise apparatus of the '115 patent can do so without an actual flywheel. '115 patent, 3:28 ("The present invention can be used to eliminate or reduce the size of conventional flywheels."). And even if a broader claim construction is used, the '115 patent still teaches this limitation.

91. The exercise apparatus of the '115 patent is not limited to exercise bicycles, but includes any "exercising equipment requiring inertia loads," such as elliptical exercise machines, treadmills, and rowing machines, for example. '115 patent, 4:42-43 ("The present invention can be used in association with other exercising equipment requiring inertia loads."). For example, Fig. 1F of the '865, '015, and '964 patents discloses an unmotorized treadmill that uses a flywheel, 171, attached to the drive axle to control the velocity of the belt.

92. The '115 patent discloses a base, specifically, a frame 12. *See* '115 patent, Figure 1 & 4:44-56 (teaching "a frame 12" that "can be placed directly on the floor … or can have legs or feet").

93. The '115 patent discloses a movable member mounted to the base, the movable member defining a velocity and receiving an input force applied to the movable member by a human subject. Specifically, the '115 patent discloses a set of pedals 24, which are connected to a gear box 26 through a crank arm 23. *See* '115 patent, Fig. 1 & 5:3-14. The pedals comprise "a

means [for the user] to apply an input torque," *i.e.*, the user applies an input torque, or rotational force, to the pedals. '115 patent, 5:3-5; *see also* 2:3-6 ("the input torque is provided by an input torque means, including pedals, handles, steps, and the like, with pedals most preferred"). The pedals define an input pedal speed, which can be measured by "a tachometer generator, a digital tachometer, or the like." '115 patent, 2:45-47; *see also* 5:2-14 & claims 1, 2, & 11 (all teaching an input pedal speed).

95. The '115 patent discloses a force-generating device operably coupled to the movable member and applying a resistance force to the movable member. Specifically, the '115 patent discloses a motor 18 that is operably coupled to the pedals 24 and that applies a resistance force to the pedals 24. '115 patent, Fig. 1; 4:48-56 & 5:3-14 (teaching a motor 18, comprising a motor shaft 22 that is connected to the pedals 24 via suitable means). The '115 patent teaches that the motor "can include a DC motor, generator, alternator, hysteresis motor, eddy current devices, and the like." '115 patent, 2:6-9. The motor creates a "load torque" or "motor load torque," which "force[s] the pedal speed to equal" a calculated value, *i.e.*, the motor applies a resistance force to the pedals. '115 patent, 2:41-43.

96. The '115 patent discloses a sensor configured to provide a signal corresponding to at least one of the velocity of the movable member and an input force applied to the movable member by a human subject. The '115 patent discloses measuring both the pedal input speed and the user applied rotational force, which it calls the input torque, with sensors. With respect to the pedal input speed, the '115 patent teaches directly measuring it with "a tachometer generator, a digital tachometer, or the like." '115 patent, 2:45-47; *see also* claim 11 (teaching a tachometer as the speed detecting means). This alone is enough to meet the limitation, as the claim requires only that *either* the velocity of the movable member *or* the input force applied to

the movable member is measured with a sensor. Additionally, however, the ’115 patent also discloses “a means to measure the input torque at the pedals.” ’115 patent, 6:20-37. A person of ordinary skill would have read “a means to measure the input torque at the pedals” as disclosing a sensor to measure the input torque, *i.e.*, a sensor to measure the user applied force to the pedals.

97. The ’115 patent discloses a controller configured to control the resistance force applied to the movable member by the force-generating device based, at least in part, on a signal provided by the sensor and a haptic equation incorporating an equation of motion of a human subject performing the physical activity being simulated. Specifically, the ’115 patent discloses a computer that executes a “speed servo” control means that compares the input pedal speed, as measured by the sensor, to a “speed reference” command, which is calculated by the following equation:

$S=\int(T_p - T_1)/J$

where

S is the speed reference signal;

$T_p$ is an input torque signal;

$T_1$ is a preset load torque signal;

J is a selected value which corresponds to an inertia

98. The “speed servo” control means then “compares S to the input speed and adjusts the motor load torque to force the pedal speed to equal S.” ’115 patent, 2:14-43; *see also* 6:21-25 (“The motor current is adjusted by the speed servo which can be located on circuit board 10, to maintain a substantially constant pedal speed equal to the commanded ‘speed reference’.”); 8:45-48 (“The heart of the electronic flywheel is the generation of the ‘speed reference’ command signal. As this value changes, the pedaling speed changes because the speed servo 61 forces them to be equal.”). Thus, the control means adjusts the resistance force applied by the motor based, at least in part, on the input pedal speed as measured by a sensor.

99. In my opinion, the term "haptic equation" is indefinite, as I describe below at § XII. To the extent that the term has any reasonably definite construction, the "speed reference" equation in the '115 patent meets that definition. Based on the disclosure of the '865 patent, any reasonably definite construction of the term requires, at least, that a "haptic equation" be an "equation that provides a corrected velocity value based on the rotational force applied by the user as measured by a force sensor." The "speed reference" equation in the '115 patent calculates a velocity that simulates the speed of a flywheel. '115 patent, 8:62-65. The "speed reference" equation, moreover, explicitly has a term accounting for the input pedal torque, $T_p$, which is the rotational force applied by the user. The '115 patent discloses "a means to measure the input torque at the pedals." '115 patent, 6:20-37. A person of ordinary skill would have read "a means to measure the input torque at the pedals" as disclosing a sensor to measure the input torque, *i.e.*, a sensor to measure the rotational force to the pedals. Thus, the "speed reference" equation teaches a corrected velocity value based on the rotational force applied by the user as measured by a force sensor. To the extent that the '115 patent is read as not disclosing a force sensor, it would have been obvious to add one, as I discuss below at § IX. And even if a broader construction of "haptic equation" is used, the '115 patent still teaches this limitation.

100. Finally, the "speed reference" equation is also an equation of motion of a human subject performing the physical activity being simulated. The "speed reference" equation "electronically simulates the inertia formally provided by a large flywheel," and a user applying rotational force to the pedals of a stationary bike in order to spin a flywheel is certainly a physical activity. '115 patent, 4:30-32. The '115 patent even teaches that the "speed reference" equation can be used to "simulate[] tours over hills." '115 patent, 9:62-65; *see also* claim 5

("The stationary exercise bicycle in accordance with claim 3 wherein said preset load torque comprises a varying series of simulated tours over hills.").

101. Accordingly, it is my opinion that the '115 patent discloses every limitation of claim 16 of the '865 patent and, therefore, anticipates claim 16 of the '865 patent.

### B. The '115 Patent Anticipates or Renders Obvious the Asserted Dependent Claims of the '865 Patent

102. Claim 18 of the '865 Patent. Claim 18 recites: "The apparatus of claim 16, wherein: the haptic equation relates the velocity to a time integral of the force." The '115 patent discloses this limitation. As taught by the '115 patent, the velocity depends on "the integral of the net torque," or user applied force, as approximated by summation. '115 patent, 8:62-67. This limitation recites nothing more than a general principle of physics—the "time integral of the force" is the same thing as the total work that the user applies to the system, which would necessarily influence the velocity. It simply recites the well-known physical relationship between the user applied force and the resulting velocity—the more force that the user has applied to the device, the faster its speed. Claim 18 does nothing more than merely recite this well-known and predictable result, which is obvious as a matter of general physics.

103. Claim 20 of the '865 Patent. Claim 20 recites: "The apparatus of claim 16, including: a restraint adapted to react a force applied by a human subject." The '115 patent discloses pedals, which it teaches are a "means to apply the input torque," *i.e.*, the pedals react the force applied by the user. '115 patent, 5:3-4.

104. Claim 21 of the '865 Patent. Claim 21 recites: "The apparatus of claim 20, wherein: the sensor determines a force applied to the restraint." The '115 patent discloses "a means to measure the input torque at the pedals." '115 patent, 6:20-37. A person of ordinary skill would have read "a means to measure the input torque at the pedals" as disclosing a sensor

to measure the input torque, *i.e.*, a sensor to measure the user applied force to the pedals. Thus, the "speed reference" equation provides a corrected velocity value based on the force applied by the user as measured by a force sensor. To the extent that the '115 patent is read as not disclosing a force sensor, it would have been obvious to add one, as I discuss below at § IX.

105. Claim 24 of the '865 Patent. Claim 24 recites: "The apparatus of claim 16, wherein: the controller calculates at least one of a target input force and a target velocity utilizing a haptic equation of motion and controls the force-generating device based on at least one of the target input force and a target velocity. The '115 patent discloses this limitation. Specifically, the '115 patent calculates a "speed reference" command, which provides a corrected velocity value that simulates the speed of a flywheel. '115 patent, 8:62-65. As I describe above, the "speed reference" equation is used to control the resistance provided by the motor and is a haptic equation, to the extent that term has any reasonably definition construction.

### C. The '115 Patent Anticipates or Renders Obvious Independent Claims 1 and 10 of the '015 Patent

#### 1. Claim 1 of the '015 Patent

106. It is my opinion that the '115 patent anticipates claim 1 of the '015 patent. Claim 1 recites:

> 1. A method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of the movable component to simulate the effects of changes in momentum that occur during the physical activity, the method comprising:
>
> determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus, wherein the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity;
>
> determining a value of a variable corresponding to at least one of a user's mass, a velocity of the movable component of the exercise

> apparatus, and a force applied to a component of the exercise apparatus during use thereof;
>
> providing a controller;
>
> configuring the controller to control at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on a control parameter determined at least in part by the value of the variable and the equation of motion for the physical activity being simulated by the apparatus.

107. The ’115 patent expressly discloses each limitation of this claim.

108. The ’115 patent discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of the movable component to simulate the effects of changes in momentum that occur during the physical activity. The ’115 patent teaches “an exercise apparatus … which electronically provides an adjustable load torque to control the intensity of an exercise session.” ’115 patent, 1:8-11; *see also* 4:39-40 (“The apparatus of the present invention is useful as an exercising apparatus”). In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim terms “providing a simulation of a corresponding physical activity involving human motion” and “simulate the effects of changes in momentum” should be construed as “making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass.” The exercise apparatus and methods of the ’115 patent meets this definition. As discussed below, the exercise apparatus of the ’115 patent calculates a velocity that simulates the speed of a flywheel based on the input torque, or the rotational force applied by the user, as measured by a force sensor. *E.g.* ’115 patent, 2:14-43; 6:21-25; 8:62-65. The exercise apparatus of the ’115 patent can do so without an actual

flywheel. ’115 patent, 3:28 (“The present invention can be used to eliminate or reduce the size of conventional flywheels.”). And even if a broader claim construction is used, the ’115 patent still teaches this limitation.

109. The exercise apparatus of the ’115 patent is not limited to exercise bicycles, but includes any “exercising equipment requiring inertia loads,” such as elliptical exercise machines, treadmills, and rowing machines, for example. ’115 patent, 4:42-43 (“The present invention can be used in association with other exercising equipment requiring inertia loads.”). For example, Fig. 1F of the ’865, ’015, and ’964 patents discloses an unmotorized treadmill that uses a flywheel, 171, attached to the drive axle to control the velocity of the belt.

110. The ’115 patent discloses determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus, wherein the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity. The “speed reference” equation in the ’115 patent calculates a velocity that simulates the speed of a flywheel. ’115 patent, 8:62-65. The “speed reference” equation is an equation of motion of a human subject performing the physical activity being simulated and it “electronically simulates the inertia formally provided by a large flywheel.” ’115 patent, 4:30-32. The “speed reference” equation includes a term that accounts for changes in momentum and a term for the input torque, $T_p$, which is the rotational force applied by the user to the pedals. ’115 patent, 2:21-40.

111. The ’115 patent discloses determining a value of a variable corresponding to at least one of a user’s mass, a velocity of the movable component of the exercise apparatus, and a force applied to a component of the exercise apparatus during use thereof. The ’115 patent teaches determining the velocity of the movable component by measuring the input speed and

also teaches determining the force applied by the user by measuring the input torque. ’115 patent, 2:45-47 (teaching measuring the pedal input speed with “a tachometer generator, a digital tachometer, or the like”); 6:20-37 (teaching “a means to measure the input torque at the pedals”).

112. The ’115 patent discloses providing a controller. The ’115 patent teaches a computer 60 that executes a “speed servo” control means. ’115 patent, 2:21-27; 8:10-17.

113. The ’115 patent discloses configuring the controller to control at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on a control parameter determined at least in part by the value of the variable and the equation of motion for the physical activity being simulated by the apparatus. The “speed servo” control means calculates the corrected “speed reference” signal and adjusts the resistance applied by the motor or brake to force the input speed to equal the calculated “speed reference” signal. ’115 patent, Abstract; claim 1; 2:14-20, & 6:22-23. The control means, thus, adjusts the resistance applied by the motor or brake based on the value of the calculated “speed reference” signal, which electronically simulates the inertia formally provided by a large flywheel.

115. Accordingly, it is my opinion that the ’115 patent discloses every limitation of claim 1 of the ’015 patent and, therefore, anticipates claim 1 of the ’015 patent.

**2. Claim 10 of the ’015 Patent**

116. It is my opinion that the ’115 patent anticipates claim 10 of the ’015 patent. Claim 10 recites:

> 10. A method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling the resistance of the movable component, the method comprising:

> determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus;
>
> measuring at least one of a velocity of the movable component of the exercise apparatus during use thereof, and a force applied to a component of the exercise apparatus during use thereof;
>
> providing a controller;
>
> configuring the controller to control the resistance to movement of the at least one movable component based, at least in part, on the measured velocity or force and the equation of motion for the physical activity being simulated by the apparatus.

117. The ’115 patent expressly discloses each limitation of this claim.

118. The ’115 patent discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling the resistance of the movable component. The ’115 patent teaches “an exercise apparatus … which electronically provides an adjustable load torque to control the intensity of an exercise session.” ’115 patent, 1:8-11; *see also* 4:39-40 (“The apparatus of the present invention is useful as an exercising apparatus”). In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim terms “providing a simulation of a corresponding physical activity involving human motion” and “simulate the effects of changes in momentum” should be construed as “making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass.” The exercise apparatus and methods of the ’115 patent meets this definition. As discussed below, the exercise apparatus of the ’115 patent calculates a velocity that simulates the speed of a flywheel based on the input torque, or the rotational force applied by the user, as measured by a force sensor. *E.g.* ’115 patent, 2:14-43; 6:21-25; 8:62-65. The exercise apparatus of the ’115 patent can do so without an actual flywheel. ’115 patent, 3:28 (“The present

invention can be used to eliminate or reduce the size of conventional flywheels."). And even if a broader claim construction is used, the '115 patent still teaches this limitation.

119. The exercise apparatus of the '115 patent is not limited to exercise bicycles, but includes any "exercising equipment requiring inertia loads," such as elliptical exercise machines, treadmills, and rowing machines, for example. '115 patent, 4:42-43 ("The present invention can be used in association with other exercising equipment requiring inertia loads."). For example, Fig. 1F of the '865, '015, and '964 patents discloses an unmotorized treadmill that uses a flywheel, 171, attached to the drive axle to control the velocity of the belt.

120. The '115 patent discloses determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus. The "speed reference" equation in the '115 patent calculates a velocity that simulates the speed of a flywheel. '115 patent, 8:62-65. The "speed reference" equation is an equation of motion of a human subject performing the physical activity being simulated and it "electronically simulates the inertia formally provided by a large flywheel." '115 patent, 4:30-32.

121. The '115 patent discloses measuring at least one of a velocity of the movable component of the exercise apparatus during use thereof, and a force applied to a component of the exercise apparatus during use thereof. The '115 patent teaches determining the velocity of the movable component by measuring the input speed and also teaches determining the rotational force applied by the user by measuring the input torque. '115 patent, 2:45-47 (teaching measuring the pedal input speed with "a tachometer generator, a digital tachometer, or the like"); 6:20-37 (teaching "a means to measure the input torque at the pedals").

122. The '115 patent discloses providing a controller. The '115 patent teaches a computer 60 that executes a "speed servo" control means. '115 patent, 2:21-27; 8:10-17.

123. The ’115 patent discloses configuring the controller to control the resistance to movement of the at least one movable component based, at least in part, on the measured velocity or force and the equation of motion for the physical activity being simulated by the apparatus. The “speed servo” control means calculates the corrected “speed reference” signal and adjusts the resistance applied by the motor or brake to force the input speed to equal the calculated “speed reference” signal. ’115 patent, Abstract; claim 1; 2:14-20, & 6:22-23. The control means, thus, adjusts the resistance applied by the motor or brake based on the value of the calculated “speed reference” signal, which electronically simulates the inertia formally provided by a large flywheel.

125. Accordingly, it is my opinion that the ’115 patent discloses every limitation of claim 10 of the ’015 patent and, therefore, anticipates claim 10 of the ’015 patent.

**D. The ’115 Patent Anticipates or Renders Obvious the Asserted Dependent Claims of the ’015 Patent**

126. Claim 2 of the ’015 Patent. Claim 2 recites: “The method of claim 1, wherein: the equation of motion includes a term corresponding to an incline angle of a hill involved in the physical activity being simulated; and the controller utilizes the incline angle to control the at least one movable component.” The ’115 patent teaches that the “speed reference” equation can be used to “simulate[] tours over hills.” ’115 patent, 9:62-65; *see also* claim 5 (“The stationary exercise bicycle in accordance with claim 3 wherein said preset load torque comprises a varying series of simulated tours over hills.”); 4:27-29 (‘the actual load torque setting can slowly vary with time such as when simulating riding a bicycle up and down hills”). Specifically, the ’115 patent teaches that the “load torque,” or $T_1$ in the disclosed equation, can be adjusted to simulate the incline of a hill. ’115 patent, 4:27-29; 9:62-65. The “speed servo” control means then

"compares S to the input speed and adjusts the motor load torque to force the pedal speed to equal S." '115 patent, 2:14-43; *see also* 6:21-25.

127. Claim 4 of the '015 Patent. Claim 4 recites: "The method of claim 1, including: utilizing the equation of motion to determine a corresponding haptic equation including a measured velocity and an update velocity; and controlling the movable component based, at least in part, on the update velocity." The '115 patent uses an equation of motion to determine a corresponding haptic equation—to the extent the term "haptic equation" has any reasonably definition construction, see below at § XII—including a measured velocity and an update velocity; and controls the movable component based, at least in part, on the update velocity. Specifically, the '115 patent calculates a "speed reference" command, which is a calculated velocity meant to simulate the speed of a flywheel, and then compares it to the measured velocity. '115 patent, 2:14-43; 6:21-25; 8:62-65. Based on that comparison, the control means of the '115 patent "adjusts the motor load torque to force the pedal speed to equal S." '115 patent, 2:14-43. And even if a broader construction of "haptic equation" is used, the '115 patent still teaches this limitation.

128. Claim 9 of the '015 Patent. Claim 9 recites: "The method of claim 1, wherein: the exercise apparatus includes a brake that varies the resistance to movement of the movable member; and the controller controls the brake." The '115 patent discloses that the "load torque means to provide the load torque can include a DC motor, generator, alternator, hysteresis motor, eddy current devices, and the like," where the term "eddy current device[]" would be understood by a person of ordinary skill as including an eddy current brake. *See* U.S. Patent No. 5,656,001 (teaching eddy current brakes).

### E. The ’115 Patent Anticipates or Renders Obvious Independent Claim 1 of the ’964 Patent

129. It is my opinion that the ’115 patent anticipates claim 1 of the ’964 patent. Claim 1 recites:

> 1. A method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of the movable component to simulate the effects of changes in momentum that occur during the physical activity being simulated, the method comprising:
>
> determining an applied force that is applied to a component of the exercise apparatus by a user during use thereof by measuring an operating parameter of the stationary exercise apparatus that is related to an applied force that is applied to a component of the exercise apparatus by a user during use thereof;
>
> determining a virtual velocity of the physical activity being simulated, wherein the estimate of a target velocity comprises an estimate of a velocity that would occur during the physical activity being simulated if the applied force had been applied by a user during an actual physical activity;
>
> determining an actual velocity based on a measured velocity of the movable component of the stationary exercise apparatus;
>
> comparing the actual velocity of the virtual velocity; and
>
> controlling at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on the comparison of the actual velocity to the virtual velocity.

130. The ’115 patent expressly discloses each limitation of this claim.

131. The ’115 patent discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of the movable component to simulate the effects of changes in momentum that occur during the physical activity being simulated. The ’115 patent teaches “an exercise apparatus … which electronically provides an

adjustable load torque to control the intensity of an exercise session." '115 patent, 1:8-11; *see also* 4:39-40 ("The apparatus of the present invention is useful as an exercising apparatus"). In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim terms "providing a simulation of a corresponding physical activity involving human motion" and "simulate the effects of changes in momentum" should be construed as "making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass." The exercise apparatus and methods of the '115 patent meets this definition. As discussed below, the exercise apparatus of the '115 patent calculates a velocity that simulates the speed of a flywheel based on the input torque, or the rotational force applied by the user, as measured by a force sensor. *E.g.* '115 patent, 2:14-43; 6:21-25; 8:62-65. The exercise apparatus of the '115 patent can do so without an actual flywheel. '115 patent, 3:28 ("The present invention can be used to eliminate or reduce the size of conventional flywheels."). And even if a broader claim construction is used, the '115 patent still teaches this limitation.

132. The exercise apparatus of the '115 patent is not limited to exercise bicycles, but includes any "exercising equipment requiring inertia loads," such as elliptical exercise machines, treadmills, and rowing machines, for example. '115 patent, 4:42-43 ("The present invention can be used in association with other exercising equipment requiring inertia loads."). For example, Fig. 1F of the '865, '015, and '964 patents discloses an unmotorized treadmill that uses a flywheel, 171, attached to the drive axle to control the velocity of the belt.

133. The '115 patent discloses determining an applied force that is applied to a component of the exercise apparatus by a user during use thereof by measuring an operating parameter of the stationary exercise apparatus that is related to an applied force that is applied to

a component of the exercise apparatus by a user during use thereof. The ’115 patent determines the input torque signal or $T_p$, which is the rotational force the user applies to the pedals. ’115 patent, 2:21-40; *see also* Fig. 3 & 4:10 (describing the “input torque by the operator”). The ’115 patent also teaches “a means to measure the input torque at the pedals.” ’115 patent, 6:20-21. Thus, the ’115 patent measures and determines the user applied force.

134. The ’115 patent discloses determining a virtual velocity of the physical activity being simulated, wherein the estimate of a target velocity comprises an estimate of a velocity that would occur during the physical activity being simulated if the applied force had been applied by a user during an actual physical activity. The “speed reference” equation in the ’115 patent calculates a velocity that simulates the speed of a flywheel. ’115 patent, 8:62-65. The “speed reference” equation is an equation of motion of a human subject performing the physical activity being simulated and it “electronically simulates the inertia formally provided by a large flywheel.” ’115 patent, 4:30-32. The “speed reference” equation, therefore, calculates a target velocity (or corrected or virtual velocity) that would occur during physical activity, if the user applied the same force.

135. The ’115 patent discloses comparing the actual velocity of the virtual velocity. The ’115 patent compares the input speed (*i.e.*, the user’s speed) to the calculated “speed reference” signal. ’115 patent, Abstract; claim 1; 2:14-20, & 6:22-23.

136. The ’115 patent discloses controlling at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on the comparison of the actual velocity to the virtual velocity. The ’115 patent discloses adjusting the resistance applied by the motor or brake to force the input speed to equal the calculated “speed reference” signal. ’115 patent, Abstract;

claim 1; 2:14-20, & 6:22-23. In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim term "simulate the effects of changes in momentum" should be construed as "making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass." The exercise apparatus of the '115 patent meets this definition. The exercise apparatus of the '115 patent calculates a velocity that simulates the speed of a flywheel based on the input torque, or the rotational force applied by the user, as measured by a force sensor. *E.g.* '115 patent, 2:14-43; 6:21-25; 8:62-65. The exercise apparatus of the '115 patent can do so without an actual flywheel. '115 patent, 3:28 ("The present invention can be used to eliminate or reduce the size of conventional flywheels."). And even if a broader construction is used, the '115 patent still discloses this limitation.

137. Accordingly, it is my opinion that the '115 patent discloses every limitation of claim 10 of the '015 patent and, therefore, anticipates claim 10 of the '015 patent.

### F. The '115 Patent Anticipates or Renders Obvious the Asserted Dependent Claims of the '964 Patent

138. Claim 2 of the '964 Patent. Claim 2 recites: "The method of claim 1, wherein: the resistance to movement of the at least one movable component is increased if the actual velocity is greater than the virtual velocity." The '115 patent discloses this limitation by adjusting the resistance applied by the motor to force the calculated "speed reference" signal to equal the pedal input speed. '115 patent, Abstract; claim 1; 2:14-20, & 6:22-23. Thus, where the measured input speed is greater than the calculated "speed reference" signal, the control means of the '115 patent will increase the resistance applied by the motor or brake.

139. Claim 3 of the '964 Patent. Claim 3 recites: "The method of claim 1, wherein: the resistance to movement of the at least one movable component is decreased if the actual

velocity is less than the virtual velocity." The '115 patent discloses this limitation by adjusting the resistance applied by the motor to force the calculated "speed reference" signal to equal the pedal input speed. '115 patent, Abstract; claim 1; 2:14-20, & 6:22-23. Thus, where the measured input speed is less than the calculated "speed reference" signal, the control means of the '115 patent will decrease the resistance applied by the motor or brake.

140. Claim 4 of the '964 Patent. Claim 4 recites: "The method of claim 1, wherein: the virtual velocity is determined utilizing an equation of motion for the corresponding physical activity involving human motion." The '115 patent uses an equation of motion to determine a corresponding haptic equation—to the extent the term "haptic equation" has any reasonably definition construction, see below at § XII—to calculate a "speed reference" signal, which is a calculated velocity meant to simulate the speed of a flywheel, and then compares it to the measured velocity. '115 patent, 2:14-43; 6:21-25; 8:62-65.

141. Claim 5 of the '964 Patent. Claim 5 recites: "The method of claim 4, wherein: the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity." The "speed reference" equation of the '115 patent is an equation of motion of a human subject performing the physical activity being simulated and it "electronically simulates the inertia formally provided by a large flywheel." '115 patent, 4:30-32. The "speed reference" equation includes a term that accounts for changes in momentum and a term for the input torque, $T_p$, which is the force applied by the user to the pedals. '115 patent, 2:21-40.

142. Claim 6 of the '964 Patent. Claim 6 recites: "The method of claim 1, wherein: the steps of determining a virtual velocity, determining an actual velocity, and comparing the actual velocity to the virtual velocity occur at a rate of at least ten times per second." The '115

patent teaches that the "updating of the 'speed reference' is preferably performed at a sampling rate of 100 times per second (or every 10 milliseconds)." '115 patent, 8:18-20. Figure 5 of the '115 patent also teaches calculating the "speed reference" signal and comparing it to the measured input pedal speed every 10 milliseconds.

143. Claim 7 of the '964 Patent. Claim 7 recites: "The method of claim 1, wherein: the stationary exercise apparatus includes a brake that selectively increases resistance of the movable component upon actuation of the brake, and including: selectively actuating the brake to control resistance to movement of the one movable component." The '115 patent discloses that the "load torque means to provide the load torque can include a DC motor, generator, alternator, hysteresis motor, eddy current devices, and the like," where the term "eddy current device[]" would be understood by a person of ordinary skill as including an eddy current brake. The '115 patent discloses adjusting the resistance applied by the brake to force the input speed to equal the calculated "speed reference" signal. '115 patent, Abstract; claim 1; 2:14-20, & 6:22-23.

### G. The '115 Patent Anticipates or Renders Obvious Independent Claim 1 and 28 of the '476 Patent

#### 1. Claim 1 of the '476 Patent

144. It is my opinion that the '115 patent anticipates claim 1 of the '476 patent. Claim 1 recites:

> 1. An exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity, the exercise device comprising:
>
> a structural support;
>
> a user input member movably connected to the structural support for movement relative to the structural support to define a measured velocity that is measured during application of an input force to the input member by a user, and wherein the user input

> member defines a variable resistance force tending to resist movement due to input force applied by a user;
>
> a control system that utilizes a velocity difference between the measured velocity and a virtual velocity as a control input to control the resistance force on the user input member, wherein the control system is configured to continuously and rapidly recalculate the virtual velocity while an input force is being applied to the input member by a user, and wherein the control system is configured to determine the virtual velocity, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force for the human physical activity being simulated and wherein the control system is configured to continuously and rapidly recalculate the velocity difference while an input force is being applied to the input member by a user such that the resistance force varies to simulate the changes in force experienced by a user due to changes in momentum of the human physical activity that is being simulated.

145. The ’115 patent expressly discloses each limitation of this claim.

146. The ’115 patent discloses an exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity. The ’115 patent teaches “an exercise apparatus … which electronically provides an adjustable load torque to control the intensity of an exercise session.” ’115 patent, 1:8-11; *see also* 4:39-40 (“The apparatus of the present invention is useful as an exercising apparatus”). The exercise apparatus of the ’115 patent uses an equation of motion, the “speed reference” equation, to calculate a velocity that simulates the speed of a flywheel based on the input torque, or the force applied by the user, as measured by a force sensor. *E.g.* ’115 patent, 2:14-43; 6:21-25; 8:62-65. The exercise apparatus of the ’115 patent can do so without an actual flywheel. ’115 patent, 3:28 (“The present invention can be used to eliminate or reduce the size of conventional flywheels.”). The “speed reference” equation “electronically simulates

the inertia formally provided by a large flywheel," and a user applying rotational force to the pedals of a stationary bike in order to spin a flywheel is a physical activity. '115 patent, 4:30-32. The '115 patent even teaches that the "speed reference" equation can be used to "simulate[] tours over hills." '115 patent, 9:62-65; *see also* claim 5 ("The stationary exercise bicycle in accordance with claim 3 wherein said preset load torque comprises a varying series of simulated tours over hills.").

147. The '115 patent discloses a structural support. The '115 patent discloses a base, specifically, a frame 12. *See* '115 patent, Figure 1 & 4:44-56 (teaching "a frame 12" that "can be placed directly on the floor … or can have legs or feet").

148. The '115 patent discloses a user input member movably connected to the structural support for movement relative to the structural support to define a measured velocity that is measured during application of an input force to the input member by a user. Specifically, the '115 patent discloses a set of pedals 24, which are connected to a gear box 26 through a crank arm 23. *See* '115 patent, Fig. 1 & 5:3-14. The pedals comprise "a means [for the user] to apply an input torque," *i.e.*, the user applies an input torque, or rotational force, to the pedals. '115 patent, 5:3-5; *see also* 2:3-6 ("the input torque is provided by an input torque means, including pedals, handles, steps, and the like, with pedals most preferred"). The pedals define an input pedal speed, which can be measured by "a tachometer generator, a digital tachometer, or the like." '115 patent, 2:45-47; *see also* 5:2-14 & claims 1, 2, & 11 (all teaching an input pedal speed).

150. The '115 patent discloses that the user input member defines a variable resistance force tending to resist movement due to input force applied by a user. Specifically, the '115 patent discloses a motor 18 that is operably coupled to the pedals 24 and that applies a resistance

force to the pedals 24. ’115 patent, Fig. 1; 4:48-56 & 5:3-14 (teaching a motor 18, comprising a motor shaft 22 that is connected to the pedals 24 via suitable means). The ’115 patent teaches that the motor “can include a DC motor, generator, alternator, hysteresis motor, eddy current devices, and the like.” ’115 patent, 2:6-9. The motor creates a “load torque” or “motor load torque,” which “force[s] the pedal speed to equal” a calculated value, *i.e.*, the motor applies a resistance force to the pedals. ’115 patent, 2:41-43.

151. The ’115 patent discloses a control system that utilizes a velocity difference between the measured velocity and a virtual velocity as a control input to control the resistance force on the user input member. The ’115 patent compares the input speed (*i.e.*, the user’s speed) to the calculated “speed reference” signal. ’115 patent, Abstract; claim 1; 2:14-20, & 6:22-23. The ’115 patent discloses adjusting the resistance applied by the motor or brake to force the input speed to equal the calculated “speed reference” signal. ’115 patent, Abstract; claim 1; 2:14-20, & 6:22-23. The exercise apparatus of the ’115 patent calculates a velocity that simulates the speed of a flywheel based on the input torque, or the force applied by the user, as measured by a force sensor. *E.g.* ’115 patent, 2:14-43; 6:21-25; 8:62-65.

152. The ’115 patent discloses that the control system is configured to continuously and rapidly recalculate the virtual velocity while an input force is being applied to the input member by a user. The ’115 patent teaches that the “updating of the ‘speed reference’ is preferably performed at a sampling rate of 100 times per second (or every 10 milliseconds).” ’115 patent, 8:18-20. Figure 5 of the ’115 patent also teaches calculating the “speed reference” signal and comparing it to the measured input pedal speed every 10 milliseconds.

153. The ’115 patent discloses that the control system is configured to determine the virtual velocity, at least in part, utilizing an equation of motion of the type that describes the

acceleration of a mass under an influence of a force for the human physical activity being simulated. The "speed reference" equation in the '115 patent calculates a velocity that simulates the speed of a flywheel. '115 patent, 8:62-65. The "speed reference" equation is an equation of motion of a human subject performing the physical activity being simulated and it "electronically simulates the inertia formally provided by a large flywheel." '115 patent, 4:30-32. The "speed reference" equation, therefore, calculates a target velocity that would occur during physical activity, if the user applied the same force.

154. The '115 patent discloses that the control system is configured to continuously and rapidly recalculate the velocity difference while an input force is being applied to the input member by a user such that the resistance force varies to simulate the changes in force experienced by a user due to changes in momentum of the human physical activity that is being simulated. The control system of the '115 patent, referred to as the "speed servo," "compares S [the "speed reference" signal] to the input speed and adjusts the motor load torque to force the pedal speed to equal S." '115 patent, 41-43. As the '115 patent teaches, the "speed servo" control, which compares the calculated velocity to the measured velocity, operates in a "continuous" rather than "sampled" manner.

155. Accordingly, it is my opinion that the '115 patent discloses every limitation of claim 1 of the '476 patent and, therefore, anticipates claim 1 of the '476 patent.

**2. Claim 28 of the '476 Patent**

156. It is my opinion that the '115 patent anticipates claim 28 of the '476 patent. Claim 28 recites:

> 28. An exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the

> acceleration of a mass under an influence of a force generated by a human in performing the activity, the exercise device comprising:
>
> a structural support;
>
> a user input member movably connected to the structural support for movement relative to the structural support to define a measured variable upon application of an input force to the input member by a user, and wherein the user input member defines a variable resistance force tending to resist movement due to input force applied by a user;
>
> a control system configured to utilize first and second values of the measured variable that are both measured while a user is applying an input force to the input member, and wherein the first value is measured before the second value, and wherein the control system is configured to determine a difference between the first value of the measured variable, and a first value of a virtual variable as a control input to control the resistance force on the user input member, wherein the control system is configured to determine the virtual variable, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force input by a human for the human physical activity being simulated, and wherein the control system is configured to utilize the first value of the measured variable as an input variable in the equation of motion such that the resistance force varies in a manner that simulates changes in force due to changes in momentum according to the equation of motion.

157. The ’115 patent expressly discloses each limitation of this claim.

158. The ’115 patent discloses an exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity. The ’115 patent teaches “an exercise apparatus … which electronically provides an adjustable load torque to control the intensity of an exercise session.” ’115 patent, 1:8-11; *see also* 4:39-40 (“The apparatus of the present invention is useful as an exercising apparatus”). The exercise apparatus of the ’115 patent uses an equation of motion, the “speed reference” equation, to calculate a velocity that simulates the speed of a flywheel based

on the input torque, or the force applied by the user, as measured by a force sensor. *E.g.* ’115 patent, 2:14-43; 6:21-25; 8:62-65. The exercise apparatus of the ’115 patent can do so without an actual flywheel. ’115 patent, 3:28 (“The present invention can be used to eliminate or reduce the size of conventional flywheels.”). The “speed reference” equation “electronically simulates the inertia formally provided by a large flywheel,” and a user applying rotational force to the pedals of a stationary bike in order to spin a flywheel is a physical activity. ’115 patent, 4:30-32. The ’115 patent even teaches that the “speed reference” equation can be used to “simulate[] tours over hills.” ’115 patent, 9:62-65; *see also* claim 5 (“The stationary exercise bicycle in accordance with claim 3 wherein said preset load torque comprises a varying series of simulated tours over hills.”).

159. The ’115 patent discloses a structural support. The ’115 patent discloses a base, specifically, a frame 12. *See* ’115 patent, Figure 1 & 4:44-56 (teaching “a frame 12” that “can be placed directly on the floor … or can have legs or feet”).

160. The ’115 patent discloses a user input member movably connected to the structural support for movement relative to the structural support to define a measured variable upon application of an input force to the input member by a user. Specifically, the ’115 patent discloses a set of pedals 24, which are connected to a gear box 26 through a crank arm 23. *See* ’115 patent, Fig. 1 & 5:3-14. The pedals comprise “a means [for the user] to apply an input torque,” *i.e.*, the user applies an input torque, or force, to the pedals. ’115 patent, 5:3-5; *see also* 2:3-6 (“the input torque is provided by an input torque means, including pedals, handles, steps, and the like, with pedals most preferred”). The pedals define an input pedal speed, which can be measured by “a tachometer generator, a digital tachometer, or the like.” ’115 patent, 2:45-47; *see also* 5:2-14 & claims 1, 2, & 11 (all teaching an input pedal speed).

162. The '115 patent discloses that the user input member defines a variable resistance force tending to resist movement due to input force applied by a user. Specifically, the '115 patent discloses a motor 18 that is operably coupled to the pedals 24 and that applies a resistance force to the pedals 24. '115 patent, Fig. 1; 4:48-56 & 5:3-14 (teaching a motor 18, comprising a motor shaft 22 that is connected to the pedals 24 via suitable means). The '115 patent teaches that the motor "can include a DC motor, generator, alternator, hysteresis motor, eddy current devices, and the like." '115 patent, 2:6-9. The motor creates a "load torque" or "motor load torque," which "force[s] the pedal speed to equal" a calculated value, *i.e.*, the motor applies a resistance force to the pedals. '115 patent, 2:41-43.

163. The '115 patent discloses a control system configured to utilize first and second values of the measured variable that are both measured while a user is applying an input force to the input member. The '115 patent measures the input speed at frequent intervals, which results in measuring a first and second input speed as the user is applying force. '115 patent, 2:21-57.

164. The '115 patent discloses that the first value is measured before the second value, and wherein the control system is configured to determine a difference between the first value of the measured variable, and a first value of a virtual variable as a control input to control the resistance force on the user input member. The '115 patent necessarily measures a first input speed before measuring it a second time. The '115 patent compares the input speed (*i.e.*, the user's speed) to the calculated "speed reference" signal. '115 patent, Abstract; claim 1; 2:14-20, & 6:22-23. The '115 patent discloses adjusting the resistance applied by the motor or brake to force the input speed to equal the calculated "speed reference" signal. '115 patent, Abstract; claim 1; 2:14-20, & 6:22-23. The exercise apparatus of the '115 patent calculates a velocity

that simulates the speed of a flywheel based on the input torque, or the force applied by the user, as measured by a force sensor. *E.g.* '115 patent, 2:14-43; 6:21-25; 8:62-65.

165. The '115 patent discloses that the control system is configured to determine the virtual variable, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force input by a human for the human physical activity being simulated. The "speed reference" equation in the '115 patent calculates a virtual velocity that simulates the speed of a flywheel. '115 patent, 8:62-65. The "speed reference" equation is an equation of motion of a human subject performing the physical activity being simulated and it "electronically simulates the inertia formally provided by a large flywheel." '115 patent, 4:30-32. The "speed reference" equation, therefore, calculates a target velocity that would occur during physical activity, if the user applied the same force.

166. The '115 patent discloses that the control system is configured to utilize the first value of the measured variable as an input variable in the equation of motion such that the resistance force varies in a manner that simulates changes in force due to changes in momentum according to the equation of motion. The disclosed "speed reference," an equation of motion, is compared to a first measured velocity in a manner that simulated changes in force due to changes in momentum. The "speed reference" equation in the '115 patent calculates a velocity that simulates the speed of a flywheel. '115 patent, 8:62-65. The "speed reference" equation is an equation of motion of a human subject performing the physical activity being simulated and it "electronically simulates the inertia formally provided by a large flywheel." '115 patent, 4:30-32. The "speed reference" equation, therefore, calculates a target velocity that would occur during physical activity, if the user applied the same force.

167. Accordingly, it is my opinion that the '115 patent discloses every limitation of claim 28 of the '476 patent and, therefore, anticipates claim 28 of the '476 patent.

### H. The '115 Patent Anticipates or Renders Obvious the Asserted Dependent Claims of the '476 Patent

168. Claim 2 of the '476 Patent. Claim 2 recites: "The exercise device of claim 1, wherein: the control system includes a sensor that measures a variable associated with movement and the user input member from which a velocity of the user input member can be determined." The '115 patent discloses this limitation. With respect to the pedal input speed, the '115 patent teaches directly measuring it with "a tachometer generator, a digital tachometer, or the like." '115 patent, 2:45-47; *see also* claim 11 (teaching a tachometer as the speed detecting means).

169. Claim 3 of the '476 Patent. Claim 3 recites: "The exercise device of claim 2, wherein: the control system includes a force-generating device that supplies the variable resistance force." The '115 patent discloses this limitation. Specifically, the '115 patent discloses a motor 18 that is operably coupled to the pedals 24 and that applies a resistance force to the pedals 24. '115 patent, Fig. 1; 4:48-56 & 5:3-14 (teaching a motor 18, comprising a motor shaft 22 that is connected to the pedals 24 via suitable means). The '115 patent teaches that the motor "can include a DC motor, generator, alternator, hysteresis motor, eddy current devices, and the like." '115 patent, 2:6-9. The motor creates a "load torque" or "motor load torque," which "force[s] the pedal speed to equal" a calculated value, *i.e.*, the motor applies a resistance force to the pedals. '115 patent, 2:41-43.

170. Claim 6 of the '476 Patent. Claim 6 recites: "The exercise device of claim 3, wherein: the control system includes a controller connected to the sensor and the force-generating device and sending a signal to the force-generating device based, at least in part, on a signal from the sensor." The '115 patent discloses this limitation. The '115 patent discloses a

speed sensor, like a tachometer, to measure the speed. ’115 patent, 2:45-47. Then, the “speed servo” control means “compares S to the input speed and adjusts the motor load torque to force the pedal speed to equal S.” ’115 patent, 2:14-43; *see also* 6:21-25 (“The motor current is adjusted by the speed servo which can be located on circuit board 10, to maintain a substantially constant pedal speed equal to the commanded ‘speed reference’.”); 8:45-48 (“The heart of the electronic flywheel is the generation of the ‘speed reference’ command signal. As this value changes, the pedaling speed changes because the speed servo 61 forces them to be equal.”). Thus, the control means adjusts the resistance force applied by the motor based, at least in part, on the input pedal speed as measured by a sensor.

171. Claim 8 of the ’476 Patent. Claim 8 recites: “The exercise device of claim 6, wherein: the controller updates the virtual velocity in a manner that takes into account the effects of momentum.” The ’115 patent discloses this limitation. The “speed reference” equation in the ’115 patent calculates a velocity that simulates the speed of a flywheel. ’115 patent, 8:62-65. The “speed reference” equation is an equation of motion of a human subject performing the physical activity being simulated and it “electronically simulates the inertia formally provided by a large flywheel.” ’115 patent, 4:30-32. The “speed reference” equation takes into account the effects of momentum, at least by having a term that accounts the input torque, $T_p$, which is the force applied by the user to the pedals. ’115 patent, 2:21-40.

172. Claim 9 of the ’476 Patent. Claim 9 recites: “The exercise device of claim 8, wherein: the controller utilizes a linear relationship between acceleration and force to determine the effects of momentum.” The ’115 patent discloses this limitation. According to the disclosed “speed reference” equation, as the user applied rotational force to the pedals, or input torque $T_p$, is increased, the input speed over time, *i.e.*, the acceleration, likewise is increased. ’115 patent,

2:56-57 ("the input torque is required for acceleration"). Thus, there is a linear relationship between the input speed and the resulting acceleration.

173. Claim 17 of the '476 Patent. Claim 17 recites: "The exercise device of claim 1, wherein: the control system utilizes a measured force to determine the virtual velocity." The '115 patent discloses this limitation. Specifically, the '115 patent discloses "a means to measure the input torque at the pedals," '115 patent, 6:21-22, which is the user applied force to the pedals.

174. Claim 18 of the '476 Patent. Claim 18 recites: "The exercise device of claim 1, wherein: the control system is configured to vary the resistance force in a manner that tends to minimize the velocity difference." The '115 patent discloses this limitation. The '115 patent minimizes the difference between the measured input speed and the calculated "speed reference" signal. '115 patent, Abstract (the control system "force[s] the input speed to equal the speed reference command signal"); 2:41-43 ("The 'speed servo' compares S to the input speed and adjusts the motor load torque to force the pedal speed to equal S."); claim 1.

175. Claim 19 of the '476 Patent. Claim 19 recites: "The exercise device of claim 1, wherein: the control system is configured to vary the resistance force in a manner that drives the velocity difference to a predetermined value." The '115 patent discloses this limitation. The '115 patent varies the resistance force in a manner that drives the velocity difference between the measured input speed and the calculated "speed reference" signal to a predetermined value—namely, that they be equal. '115 patent, Abstract (the control system "force[s] the input speed to equal the speed reference command signal"); 2:41-43 ("The 'speed servo' compares S to the input speed and adjusts the motor load torque to force the pedal speed to equal S."); claim 1.

## VIII. German Patent No. 4118082 Anticipates or Renders Obvious the Asserted Claims

176. German Patent No. 4118082 ("DE '082") is prior art to all of the asserted patents. It was published on March 4, 1993, which is more than one year before the priority date of the

’865, ’015, and ’964 patents (regardless of whether those are entitled to a priority date of June 9, 1998 or June 7, 1999) and more than one year before the priority date of the ’476 patent.

177. DE ’082 is directed to a method and an assembly for simulating a flywheel—without the need for any actual flywheel. DE ’082 simulates the dynamic effects of a flywheel, while replacing the flywheel with the following components: a force sensor, a rotational speed sensor, a computer, a braking force intensifier and a brake. DE ’082, col. 2.

178. Based in part on the speed as measured by the speed sensor and the force as measured by the force sensor, DE ’082 calculates what the velocity of the simulated flywheel would be, *i.e.*, the virtual velocity of the simulated flywheel. DE ’082, col. 3 (continuously calculating the virtual velocity of the simulated flywheel based on inputs from the “the force and rotational speed sensors”). DE ’082 refers to this virtual velocity as “the rotational speed $n_S$ of the simulated damped flywheel,” col. 3, or “the internal rotational speed of the flywheel simulated in the computer,” claim 1, or “the rotational speed of the simulated, damped flywheel that is calculated in the computer,” col. 2.

179. DE ’082 compares the virtual velocity of the simulated flywheel to the actual velocity as measured by the speed sensor. The “difference” between these two values is “continuously calculated in the computer.” The braking force supplied by the brake is adjusted based on this comparison, so that the virtual velocity of the simulated flywheel corresponds to the actual velocity as measured by the speed sensor. DE ’082, cols. 2-3.

180. The virtual velocity of the simulated flywheel requires an equation of motion—specifically, an equation for how a flywheel would respond to the user applied forces. The virtual velocity of the simulated flywheel requires an equation of motion that provides a simulation of a corresponding physical activity involving human motion (riding an exercise bike

or even simply powering a flywheel) and that provides a simulation of the effects of changes in momentum that occur during the physical activity being simulated (how the bike or flywheel responds to the user applied forces). Though DE ’082 does not recite a specific equation, it did not need to—they were all well-known. For example, one prior art reference, U.S. Patent No. 4,786,049, states how, for an ergometer like the one simulated in DE ’082, the “calculation of the value of the momentum … is a simple matter of arithmetic.” ’049 patent, 5:51-54; see also § IV; Radow Deposition Transcript, 160:11-17 (“I mean, look, Isaac Newton figured out F=MA three-hundred and some odd years ago ….”). Likewise, the ’115 patent provides an express equation to calculate the speed of a virtual flywheel—its “speed reference” equation. ’115 patent, 2:21-52.

### A. DE ’082 Anticipates or Renders Obvious Independent Claim 16 of the ’865 Patent

181. It is my opinion that DE ’082 anticipates claim 16 of the ’865 patent, the only asserted independent claim of the ’865 patent. Claim 16 recites:

> 16. An apparatus for simulating forces and movement of a human subject during a physical activity, comprising:
>
> a base;
>
> a movable member mounted to the base, the movable member defining a velocity and receiving an input force applied to the movable member by a human subject;
>
> a force-generating device operably coupled to the movable member and applying a resistance force to the movable member;
>
> a sensor configured to provide a signal corresponding to at least one of the velocity of the movable member and an input force applied to the movable member by a human subject; and
>
> a controller configured to control the resistance force applied to the movable member by the force-generating device based, at least in part, on a signal provided by the sensor and a haptic equation incorporating an equation of motion of a human subject performing the physical activity being simulated.

182. DE ’082 expressly discloses each limitation of this claim.

183. DE ’082 discloses an apparatus for simulating forces and movement of a human subject during a physical activity. DE ’082 describes a “Method and Assembly for Generating Dynamic Resistance to Motion on an Ergometer” (54). In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim term “simulating forces and movement of a human subject during a physical activity” should be construed as “making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass.” The exercise apparatus of DE ’082 meets this definition. DE ’082 teaches calculating “the internal rotational speed of the flywheel simulated in the computer” and controlling the resistance supplied by the brake until the actual measured speed equals the “the internal rotational speed of the flywheel simulated in the computer.” DE ’082, claim 1. The “the internal rotational speed of the flywheel simulated in the computer” is calculated based, in part, on the user applied force as measured by a force sensor. DE ’082, claim 1; *see also* DE ’082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE ’082 teaches correcting the velocity to match the simulated velocity, which is calculated in part based on the user applied force as measured by a force sensor. And even if a broader construction is used, DE ’082 patent still discloses this limitation. Even if a broader construction is used, however, the limitation is still taught be DE ’082.

184. The exercise apparatus of DE ’082 is not limited to exercise bicycles. DE ’082 discloses a continuously adjustable ergometer that does not use a transmission gear, freewheel, or flywheel. DE ’082, col. 2. Such an ergometer can be used in any exercise equipment that requires inertia loads, or in which a flywheel could be used, including elliptical exercise machines, treadmills, and rowing machines. DE ’082, col. 1 (suggesting use of invention for “a

spectrum of use [that] requires different devices with special load responses and programs," including for "fitness training in the home and studio and in the medical sector for therapy, diagnosis, rehabilitation or defined stress"). For example, the '865 patent discloses use of a conventional flywheel as part of a treadmill used to simulate running or walking. '865 patent, Fig. 1F.

185. DE '082 discloses a base, specifically, a base supporting pedal shaft 1 and a brake disk 4. See, for example, the hatched area under pedal shaft in Figure 1, which illustrates how the base connects to the ergometer. Moreover, DE '082 teaches "an ***assembly*** for generating dynamic resistances to motion on an ergometer," which refers to assembling the ergometer on a base. DE '082, col. 1.

186. DE '082 discloses a movable member mounted to the base, the movable member defining a velocity and receiving an input force applied to the movable member by a human subject. DE '082 discloses a movable member, pedal shaft 1, mounted to the base. Figure 1 shows pedal shaft 1 connected to a brake disk 4, pedal arms 2 and pedals 3. The pedal shaft 1 and brake disk 2 define a velocity and receive an input force from the user applied to the pedals 3. DE '082, col. 2. DE '082 also discloses Fig. 2, which is described as disclosing how "The rotational speed of the pedal shaft np (dashed line) decreases, in proportion to the decrease in activity of the person exercising, as far as to zero." DE '082, col. 3.

187. DE '082 discloses a force-generating device operably coupled to the movable member and applying a resistance force to the movable member. Specifically, DE '082 discloses Figure 1, which shows a force-generating device, brake 5, operably coupled to the movable member, pedal shaft 1, through the permanently attached brake disk 4. The brake 5 thereby applies a resistance force to the movable member. *See* DE '082, col. 2 ("A brake 5 acts directly

on the brake disk"). The Abstract of DE '082 also states: "The breaking force of the break acts directly on the pedal shaft by means of a brake disk."

188. DE '082 discloses a sensor configured to provide a signal corresponding to at least one of the velocity of the movable member and an input force applied to the movable member by a human subject. DE '082 discloses both a force sensor and a speed sensor. First, DE '082 discloses a force sensor 6. *See* DE '082, Fig. 1 & col. 2 ("The force that is introduced to the brake disk 4 is measured by a force sensor 6. It is proportional to the moment introduced into the pedal shaft 1."). Second, DE '082 discloses a rotational speed sensor 7. *See* DE '082, Fig. 1 & col. 2 ("The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7."). The signals from the force and speed sensors are fed to a computer 8. DE '082, col. 2.

189. DE '082 discloses a controller configured to control the resistance force applied to the movable member by the force-generating device based, at least in part, on a signal provided by the sensor and a haptic equation incorporating an equation of motion of a human subject performing the physical activity being simulated. DE '082 discloses a controller (computer 8) connected to the force generating device (brake 5), with input (signals) from a force sensor 6 and speed sensor 7. DE '082 discloses a force generating device, a brake 5 that applies a braking force F. DE '082, cols. 2-3. The braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE '082, col. 3 ("The moved, moment-loaded brake disk 4, the force and rotational speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting control loop."). With respect to the force sensor, which is part of the "control and regulating device," col. 2, it is used to control the resistance supplied by the brake. The "rotational speed $n_s$ of the simulated damped

flywheel" is calculated based, in part, on the user applied force as measured by the force sensor. This can be seen, for example, in Figure 2, where section II of the figure corresponds to the user being "inactive," or not applying any force to the pedals. As Figure 2 shows, the calculated rotational speed of the simulated flywheel, or $n_s$, decreases as a function of the user applied force—where the user applied force decreases, so too does the calculated rotational speed of the simulated flywheel. This is because the rotational speed of the simulated flywheel, or $n_s$, is calculated based in part on the user applied force. With respect to the speed sensor, DE '082 teaches that "the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. That is, DE '082 adjusts the resistance of the brake so that the measured speed is equal to the calculated rotational speed of the simulated flywheel.

190. In my opinion, the term "haptic equation" is indefinite, as I describe below at § XII. To the extent that the term has any reasonably definite construction, DE '082 meets that definition. Based on the disclosure of the '865 patent, any reasonably definite construction of the term requires, at least, that a "haptic equation" be an "equation that provides a corrected velocity value based on the force applied by the user as measured by a force sensor." DE '082 discloses calculating a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. DE '082, col. 3. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE '082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In

that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

191. Accordingly, it is my opinion that DE ’082 discloses every limitation of claim 16 of the ’865 patent and, therefore, anticipates claim 16 of the ’865 patent.

### B. DE ’082 Anticipates or Renders Obvious the Asserted Dependent Claims of the ’865 Patent

192. Claim 18 of the ’865 Patent. Claim 18 recites: “The apparatus of claim 16, wherein: the haptic equation relates the velocity to a time integral of the force.” DE ’082 relates the velocity to a time integral of the force (i.e., load on the person exercising). DE ’082, col. 2. Specifically, DE ’082 discloses at col. 2:

> The parameters that determine the breaking characteristics and the dynamics of the pedal shaft of the ergometer are preset in the computer 8 by means of an input 9. These parameters (moment of inertia of the flywheel, the damping of the flywheel friction, speed limit) are used to calculate the currently necessary braking force F which is fed by way of the breaking force intensifier 10 to the brake 5, as long as the person exercising is active. The parameters can be continuously changed and can determine the load on the person exercising.

193. This limitation recites nothing more than a general principle of physics—the “time integral of the force” is the same thing as the total work that the user applies to the system, which would necessarily influence the velocity. It simply recites the well-known physical relationship between the user applied force and the resulting velocity—the more force that the user has applied to the device, the faster its speed. Claim 18 does nothing more than merely recite this well-known and predictable result, which is obvious as a matter of general physics.

194. Claim 20 of the ’865 Patent. Claim 20 recites: “The apparatus of claim 16, including: a restraint adapted to react a force applied by a human subject.” DE ’082 discloses a restraint (brake 5) that is adapted to react a force applied (via pedal 3 and pedal arm 4) by the user. *See also* DE ’082, claim 2.

195. Claim 21 of the ’865 Patent. Claim 21 recites: “The apparatus of claim 20, wherein: the sensor determines a force applied to the restraint.” DE ’082 discloses that the “force that is introduced to the brake disk 4 is measured by a force sensor 6.” DE ’082, col. 2.

196. Claim 24 of the ’865 Patent. Claim 24 recites: “The apparatus of claim 16, wherein: the controller calculates at least one of a target input force and a target velocity utilizing a haptic equation of motion and controls the force-generating device based on at least one of the target input force and a target velocity. In my opinion, the term “haptic equation” is indefinite, as I describe below at § XII. To the extent that the term is capable of any reasonably definite construction, DE ’082 discloses this limitation. Specifically, DE ’082 calculates a “rotational speed $n_s$ of the simulated damped flywheel,” which is a target velocity used to control the resistance supplied by the brake. The “rotational speed $n_s$ of the simulated damped flywheel” is calculated based, in part, on the user applied force as measured by the force sensor. The brake is varied based on a “continuous” comparison between the virtual rotational speed of the simulated flywheel and the measured speed. DE ’082, col. 3 (“The difference with respect to a real ergometer (according to the parameter settings) is continuously calculated in the computer **8**; and the brake is adjusted accordingly.”). And even if a broader construction is used, DE ’082 patent still discloses this limitation.

### C. DE ’082 Anticipates or Renders Obvious Independent Claims 1 and 10 of the ’015 Patent

#### 1. Claim 1 of the ’015 Patent

197. It is my opinion that DE ’082 anticipates claim 1 of the ’015 patent. Claim 1 recites:

> 1. A method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of

> the movable component to simulate the effects of changes in momentum that occur during the physical activity, the method comprising:
>
> > determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus, wherein the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity;
> >
> > determining a value of a variable corresponding to at least one of a user's mass, a velocity of the movable component of the exercise apparatus, and a force applied to a component of the exercise apparatus during use thereof;
> >
> > providing a controller;
> >
> > configuring the controller to control at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on a control parameter determined at least in part by the value of the variable and the equation of motion for the physical activity being simulated by the apparatus.

198. DE ’082 expressly discloses each limitation of this claim.

199. DE ’082 discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of the movable component to simulate the effects of changes in momentum that occur during the physical activity. In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim terms “providing a simulation of a corresponding physical activity involving human motion” and “simulate the effects of changes in momentum” should be construed as “making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass.” The exercise devices and methods of DE ’082 meet this definition. DE ’082 teaches calculating “the internal rotational speed of the flywheel simulated in the computer” and controlling the resistance supplied by the brake until the actual

measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. The "the internal rotational speed of the flywheel simulated in the computer" is calculated based, in part, on the user applied force as measured by a force sensor. DE '082, claim 1; *see also* DE '082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE '082 teaches correcting the velocity to match the simulated velocity, which is calculated in part based on the user applied force as measured by a force sensor. And even if a broader construction is used, DE '082 patent still discloses this limitation. Even if a broader construction is used, however, the limitation is still taught be DE '082.

200. The exercise apparatus of DE '082 is not limited to exercise bicycles. DE '082 discloses a continuously adjustable ergometer that does not use a transmission gear, freewheel, or flywheel. DE '082, col. 2. Such an ergometer can be used in any exercise equipment that requires inertia loads, or in which a flywheel could be used, including elliptical exercise machines, treadmills, and rowing machines. DE '082, col. 1 (suggesting use of invention for "a spectrum of use [that] requires different devices with special load responses and programs," including for "fitness training in the home and studio and in the medical sector for therapy, diagnosis, rehabilitation or defined stress"). For example, the '865 patent discloses use of a conventional flywheel as part of a treadmill used to simulate running or walking. '865 patent, Fig. 1F.

201. DE '082 discloses determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus, wherein the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity. DE '082 discloses using an equation

of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE ’082, col. 3 (“the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer.”). The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

202. DE ’082 discloses determining a value of a variable corresponding to at least one of a user’s mass, a velocity of the movable component of the exercise apparatus, and a force applied to a component of the exercise apparatus during use thereof. DE ’082 discloses both a force sensor and a speed sensor. First, DE ’082 discloses a force sensor 6 that measures the user applied force. *See* DE ’082, Fig. 1 & col. 2 (“The force that is introduced to the brake disk 4 is measured by a force sensor 6. It is proportional to the moment introduced into the pedal shaft 1.”). Second, DE ’082 discloses a rotational speed sensor 7 that measures the velocity of the movable component of the exercise apparatus. *See* DE ’082, Fig. 1 & col. 2 (“The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7.”). The signals from the force and speed sensors are fed to a computer 8. DE ’082, col. 2.

203. DE ’082 discloses providing a controller. DE ’082 discloses a controller (computer 8) connected to the force generating device (brake 5), with input (signals) from a force sensor 6 and speed sensor 7.

204. DE '082 discloses configuring the controller to control at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on a control parameter determined at least in part by the value of the variable and the equation of motion for the physical activity being simulated by the apparatus. DE '082 discloses that the braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE '082, col. 3 ("The moved, moment-loaded brake disk 4, the force and rotational speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting control loop."). With respect to the force sensor, which is part of the "control and regulating device," col. 2, it is used to control the resistance supplied by the brake. The "rotational speed $n_s$ of the simulated damped flywheel" is calculated based, in part, on the user applied force as measured by the force sensor. This can be seen, for example, in Figure 2, where section II of the figure corresponds to the user being "inactive," or not applying any force to the pedals. As Figure 2 shows, the calculated rotational speed of the simulated flywheel, or $n_s$, decreases as a function of the user applied force—where the user applied force decreases, so too does the calculated rotational speed of the simulated flywheel. This is because the rotational speed of the simulated flywheel, or $n_s$, is calculated based in part on the user applied force. With respect to the speed sensor, DE '082 teaches that "the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. That is, DE '082 adjusts the resistance of the brake so that the speed measured by a speed sensor is equal to the calculated rotational speed of the simulated flywheel, which is calculated in part on the user applied force as measured by a force sensor.

205. Accordingly, it is my opinion that DE ’082 discloses every limitation of claim 1 of the ’015 patent and, therefore, anticipates claim 1 of the ’015 patent.

**2. Claim 10 of the ’015 Patent**

206. It is my opinion that DE ’082 anticipates claim 10 of the ’015 patent. Claim 10 recites:

> 10. A method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling the resistance of the movable component, the method comprising:
>
> determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus;
>
> measuring at least one of a velocity of the movable component of the exercise apparatus during use thereof, and a force applied to a component of the exercise apparatus during use thereof;
>
> providing a controller;
>
> configuring the controller to control the resistance to movement of the at least one movable component based, at least in part, on the measured velocity or force and the equation of motion for the physical activity being simulated by the apparatus.

207. DE ’082 expressly discloses each limitation of this claim.

208. DE ’082 discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling the resistance of the movable component. In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim term “providing a simulation of a corresponding physical activity involving human motion” should be construed as “making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass.” The exercise devices and methods of DE ’082 meet this definition. DE ’082 teaches calculating “the internal rotational speed of the

flywheel simulated in the computer" and controlling the resistance supplied by the brake until the actual measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. The "the internal rotational speed of the flywheel simulated in the computer" is calculated based, in part, on the user applied force as measured by a force sensor. DE '082, claim 1; *see also* DE '082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE '082 teaches correcting the velocity to match the simulated velocity, which is calculated in part based on the user applied force as measured by a force sensor. And even if a broader construction is used, DE '082 patent still discloses this limitation.

209. The exercise apparatus of DE '082 is not limited to exercise bicycles. DE '082 discloses a continuously adjustable ergometer that does not use a transmission gear, freewheel, or flywheel. DE '082, col. 2. Such an ergometer can be used in any exercise equipment that requires inertia loads, or in which a flywheel could be used, including elliptical exercise machines, treadmills, and rowing machines. DE '082, col. 1 (suggesting use of invention for "a spectrum of use [that] requires different devices with special load responses and programs," including for "fitness training in the home and studio and in the medical sector for therapy, diagnosis, rehabilitation or defined stress"). For example, the '865 patent discloses use of a conventional flywheel as part of a treadmill used to simulate running or walking. '865 patent, Fig. 1F.

210. DE '082 discloses determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus. DE '082 discloses using an equation of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE '082, col. 3 ("the

rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer."). The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE '082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

211. DE '082 discloses measuring at least one of a velocity of the movable component of the exercise apparatus during use thereof, and a force applied to a component of the exercise apparatus during use thereof. DE '082 discloses both a force sensor and a speed sensor. First, DE '082 discloses a force sensor 6. *See* DE '082, Fig. 1 & col. 2 ("The force that is introduced to the brake disk 4 is measured by a force sensor 6. It is proportional to the moment introduced into the pedal shaft 1."). Second, DE '082 discloses a rotational speed sensor 7. *See* DE '082, Fig. 1 & col. 2 ("The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7."). The signals from the force and speed sensors are fed to a computer 8. DE '082, col. 2.

212. DE '082 discloses providing a controller. DE '082 discloses a controller (computer 8) connected to the force generating device (brake 5), with input (signals) from a force sensor 6 and speed sensor 7.

213. DE '082 discloses configuring the controller to control the resistance to movement of the at least one movable component based, at least in part, on the measured velocity or force and the equation of motion for the physical activity being simulated by the

apparatus. DE ’082 discloses a force generating device, a brake 5 that applies a braking force F. DE ’082, cols. 2-3. The braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE ’082, col. 3 (“The moved, moment-loaded brake disk 4, the force and rotational speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting control loop.”). With respect to the force sensor, which is part of the “control and regulating device,” col. 2, it is used to control the resistance supplied by the brake. The “rotational speed $n_s$ of the simulated damped flywheel” is calculated based, in part, on the user applied force as measured by the force sensor. This can be seen, for example, in Figure 2, where section II of the figure corresponds to the user being “inactive,” or not applying any force to the pedals. As Figure 2 shows, the calculated rotational speed of the simulated flywheel, or $n_s$, decreases as a function of the user applied force—where the user applied force decreases, so too does the calculated rotational speed of the simulated flywheel. This is because the rotational speed of the simulated flywheel, or $n_s$, is calculated based in part on the user applied force. With respect to the speed sensor, DE ’082 teaches that “the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer.” DE ’082, claim 1. That is, DE ’082 adjusts the resistance of the brake so that the measured speed is equal to the calculated rotational speed of the simulated flywheel.

214. Accordingly, it is my opinion that DE ’082 discloses every limitation of claim 10 of the ’015 patent and, therefore, anticipates claim 10 of the ’015 patent.

### D. DE ’082 Anticipates or Renders Obvious the Asserted Dependent Claims of the ’015 Patent

215. Claim 2 of the ’015 Patent. Claim 2 recites: “The method of claim 1, wherein: the equation of motion includes a term corresponding to an incline angle of a hill involved in the physical activity being simulated; and the controller utilizes the incline angle to control the at least one movable component.” It would have been obvious to combine DE ’082 with the ’115 patent, which teaches this limitation. Specifically, the ’115 patent teaches that the “speed reference” equation can be used to “simulate[] tours over hills.” ’115 patent, 9:62-65; *see also* claim 5 (“The stationary exercise bicycle in accordance with claim 3 wherein said preset load torque comprises a varying series of simulated tours over hills.”); 4:27-29 (‘the actual load torque setting can slowly vary with time such as when simulating riding a bicycle up and down hills”). Specifically, the ’115 patent teaches that the “load torque,” or $T_1$ in the disclosed equation, can be adjusted to simulate the incline of a hill. ’115 patent, 4:27-29; 9:62-65. The “speed servo” control means then “compares S to the input speed and adjusts the motor load torque to force the pedal speed to equal S.” ’115 patent, 2:14-43; *see also* 6:21-25.

216. DE ’082 itself teaches that “[a]dvantageously the moment of inertia of the simulated flywheel is continuously adjustable over a wide range,” and that therefore “the real simulation of the load of cycling [is] possible.” DE ’082, cols. 1-2. That is, DE ’082 implies what the ’115 patent makes explicit—that it can be used to simulate tours over hills. It would have been desirable for a person of ordinary skill to select this feature, because as both DE ’082 and the ’115 patent teach, it would have been desirable to closely simulate the real-world conditions of cycling. And a person of ordinary skill would have had a reasonable expectation of success, because following the known techniques and methods in the ’115 patent would have predictably yielded the ability to simulate tours over hills.

217. Claim 4 of the ’015 Patent. Claim 4 recites: “The method of claim 1, including: utilizing the equation of motion to determine a corresponding haptic equation including a measured velocity and an update velocity; and controlling the movable component based, at least in part, on the update velocity.” In my opinion, the term “haptic equation” is indefinite, as I describe below at § XII. To the extent that the term has any reasonably definite construction, DE ’082 meets that definition. Based on the disclosure of the ’865 patent, any reasonably definite construction of the term requires, at least, that a “haptic equation” be an “equation that provides a corrected velocity value based on the force applied by the user as measured by a force sensor.” DE ’082 discloses calculating a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. DE ’082, col. 3. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3. DE ’082 discloses how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel. DE ’082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force. DE ’082 discloses that the breaking force F is controlled so that the calculated velocity value $n_s$ equals the measured rotational speed. DE ’082, col. 3 & claim 1. Even if a broader construction is used, however, the limitation is still taught be DE ’082.

218. Claim 9 of the ’015 Patent. Claim 9 recites: “The method of claim 1, wherein: the exercise apparatus includes a brake that varies the resistance to movement of the movable member; and the controller controls the brake.” DE ’082 discloses a brake 5 that applies a braking force F. DE ’082, col. 3 and claim 1. The brake is controlled by a computer 8, which

continuously calculates the rotational speed of the simulated flywheel and controls the brake so that the calculated velocity of the simulated flywheel equals the measured speed. DE ’082, cols. 2-3 & claim 1.

### E. DE ’082 Anticipates or Renders Obvious Independent Claim 1 of the ’964 Patent

219. It is my opinion that DE ’082 anticipates claim 1 of the ’964 patent. Claim 1 recites:

> 1. A method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of the movable component to simulate the effects of changes in momentum that occur during the physical activity being simulated, the method comprising:
>
> determining an applied force that is applied to a component of the exercise apparatus by a user during use thereof by measuring an operating parameter of the stationary exercise apparatus that is related to an applied force that is applied to a component of the exercise apparatus by a user during use thereof;
>
> determining a virtual velocity of the physical activity being simulated, wherein the estimate of a target velocity comprises an estimate of a velocity that would occur during the physical activity being simulated if the applied force had been applied by a user during an actual physical activity;
>
> determining an actual velocity based on a measured velocity of the movable component of the stationary exercise apparatus;
>
> comparing the actual velocity of the virtual velocity; and
>
> controlling at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on the comparison of the actual velocity to the virtual velocity.

220. DE ’082 expressly discloses each limitation of this claim.

221. DE ’082 discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least

one of the movement and the resistance of the movable component to simulate the effects of changes in momentum that occur during the physical activity being simulated. In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim terms "providing a simulation of a corresponding physical activity involving human motion" and "simulate the effects of changes in momentum" should be construed as "making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass." The exercise devices and methods of DE '082 meet this definition. DE '082 teaches calculating "the internal rotational speed of the flywheel simulated in the computer" and controlling the resistance supplied by the brake until the actual measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. The "the internal rotational speed of the flywheel simulated in the computer" is calculated based, in part, on the user applied force as measured by a force sensor. DE '082, claim 1; *see also* DE '082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE '082 teaches correcting the velocity to match the simulated velocity, which is calculated in part based on the user applied force as measured by a force sensor. And even if a broader construction is used, DE '082 patent still discloses this limitation. And even if a broader construction is used, DE '082 patent still discloses this limitation. Even if a broader construction is used, however, the limitation is still taught be DE '082.

222. The exercise apparatus of DE '082 is not limited to exercise bicycles. DE '082 discloses a continuously adjustable ergometer that does not use a transmission gear, freewheel, or flywheel. DE '082, col. 2. Such an ergometer can be used in any exercise equipment that requires inertia loads, or in which a flywheel could be used, including elliptical exercise

machines, treadmills, and rowing machines. DE ’082, col. 1 (suggesting use of invention for “a spectrum of use [that] requires different devices with special load responses and programs,” including for “fitness training in the home and studio and in the medical sector for therapy, diagnosis, rehabilitation or defined stress”). For example, the ’865 patent discloses use of a conventional flywheel as part of a treadmill used to simulate running or walking. ’865 patent, Fig. 1F.

223. DE ’082 discloses determining an applied force that is applied to a component of the exercise apparatus by a user during use thereof by measuring an operating parameter of the stationary exercise apparatus that is related to an applied force that is applied to a component of the exercise apparatus by a user during use thereof. DE ’082 discloses a force sensor that measures the user applied force. *See* DE ’082, Fig. 1 & col. 2 (“The force that is introduced to the brake disk 4 is measured by a force sensor 6. It is proportional to the moment introduced into the pedal shaft 1.”).

224. DE ’082 discloses determining a virtual velocity of the physical activity being simulated, wherein the estimate of a target velocity comprises an estimate of a velocity that would occur during the physical activity being simulated if the applied force had been applied by a user during an actual physical activity. DE ’082 uses an equation to calculate a virtual velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This virtual velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3, claim 1, & Fig. 2. This calculated velocity value corresponds to the rotational speed of the simulated flywheel, providing an estimate of the velocity of the flywheel that would occur during the physical activity if the user applied force had been applied to actual flywheel. DE ’082, col. 3 & claim 1.

225. DE ’082 discloses comparing the actual velocity of the virtual velocity. DE ’082 discloses comparing the actual measured speed to the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 & claim 1.

226. DE ’082 discloses controlling at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on the comparison of the actual velocity to the virtual velocity. DE ’082 discloses controlling the braking force F based on the comparison of the actual measured speed to the virtual rotational speed of the simulated flywheel, so that the actual measured speed corresponds to the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 (“The brake 5 does not act again until the rotational speed, currently calculated in the computer, corresponds to the rotational speed measured at the brake disk.”); DE ’082, claim 1 (“the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer (8).”).

227. Accordingly, it is my opinion that DE ’082 discloses every limitation of claim 10 of the ’015 patent and, therefore, anticipates claim 10 of the ’015 patent.

### F. DE ’082 Anticipates or Renders Obvious the Asserted Dependent Claims of the ’964 Patent

228. Claim 2 of the ’964 Patent. Claim 2 recites: “The method of claim 1, wherein: the resistance to movement of the at least one movable component is increased if the actual velocity is greater than the virtual velocity.” DE ’082 discloses increasing the braking force F where the measured speed is greater than the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 & claim 1.

229. Claim 3 of the ’964 Patent. Claim 3 recites: “The method of claim 1, wherein: the resistance to movement of the at least one movable component is decreased if the actual velocity is less than the virtual velocity.” DE ’082 discloses decreasing the braking force F where the measured speed is less than the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 & claim 1.

230. Claim 4 of the ’964 Patent. Claim 4 recites: “The method of claim 1, wherein: the virtual velocity is determined utilizing an equation of motion for the corresponding physical activity involving human motion.” DE ’082 discloses using an equation of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE ’082, col. 3 (“the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer.”). The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3.

231. Claim 5 of the ’964 Patent. Claim 5 recites: “The method of claim 4, wherein: the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity.” The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. DE ’082 calculates a corrected velocity value based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3. DE ’082 discloses how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel. DE ’082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is

inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

232. Claim 6 of the ’964 Patent. Claim 6 recites: “The method of claim 1, wherein: the steps of determining a virtual velocity, determining an actual velocity, and comparing the actual velocity to the virtual velocity occur at a rate of at least ten times per second.” DE ’082 teaches “continuously” calculating the virtual rotational speed of the simulated flywheel and comparing it to the measured speed. DE ’082, col. 3; *see also* DE ’082, col. 2 (“Advantageously the moment of inertia of the simulated flywheel is continuously adjustable over a wide range.”). A person of ordinary skill would read the term “continuously” as requiring calculations that occur far more often than the claimed ten times per second. For example, the ’115 patent uses the term “continuously” to refer to a rate of every ten milliseconds, which is an order of magnitude more frequent than required by claim 7 of the ’964 patent. ’115 patent, 8:18-30 & 7:29-32. Even if a person of ordinary skill did not read the term “continuously” in DE ’082 as teaching a rate of at least ten times per second, it would have been obvious to do so. Specifically, it would have been obvious to combine DE ’082 with the teaching in the ’115 patent to calculate the virtual velocity and compare it to the measured velocity at least every 10 milliseconds. As both DE ’802 and the ’115 patent teach, “continuous” calculations are preferable, because it provides a better simulation. ’115 patent, 8:18-30 & 7:29-32; DE ’082, col. 2-3. And a person of ordinary skill would have had a reasonable expectation of success, because performing these calculations at a rate of at least ten times per second was a known technique in the prior art that predictably yielded better simulations. ’115 patent, 8:18-30 & 7:29-32.

233. Claim 7 of the ’964 Patent. Claim 7 recites: “The method of claim 1, wherein: the stationary exercise apparatus includes a brake that selectively increases resistance of the movable component upon actuation of the brake, and including: selectively actuating the brake to control resistance to movement of the one movable component.” DE ’082 discloses that the braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE ’082, col. 3 (“The moved, moment-loaded brake disk 4, the force and rotational speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting control loop.”). That is, DE ’082 adjusts the resistance of the brake so that the speed measured by a speed sensor is equal to the calculated rotational speed of the simulated flywheel, which is calculated in part on the user applied force as measured by a force sensor.

### G. DE ’082 Anticipates or Renders Obvious Independent Claim 1 and 28 of the ’476 Patent

#### 1. Claim 1 of the ’476 Patent

234. It is my opinion that DE ’082 anticipates claim 1 of the ’476 patent. Claim 1 recites:

> 1. An exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity, the exercise device comprising:
>
> a structural support;
>
> a user input member movably connected to the structural support for movement relative to the structural support to define a measured velocity that is measured during application of an input force to the input member by a user, and wherein the user input member defines a variable resistance force tending to resist movement due to input force applied by a user;

> a control system that utilizes a velocity difference between the measured velocity and a virtual velocity as a control input to control the resistance force on the user input member, wherein the control system is configured to continuously and rapidly recalculate the virtual velocity while an input force is being applied to the input member by a user, and wherein the control system is configured to determine the virtual velocity, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force for the human physical activity being simulated and wherein the control system is configured to continuously and rapidly recalculate the velocity difference while an input force is being applied to the input member by a user such that the resistance force varies to simulate the changes in force experienced by a user due to changes in momentum of the human physical activity that is being simulated.

235. DE '082 expressly discloses each limitation of this claim.

DE '082 discloses an exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity. DE '082 teaches a device and methods for "the real simulation of the load of cycling." DE '082, col. 2. DE '082 teaches calculating "the internal rotational speed of the flywheel simulated in the computer" and controlling the resistance supplied by the brake until the actual measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. DE '082 discloses using an equation of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE '082, col. 3 ("the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer."); *see also* DE '082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE '082 simulates

physical activity in a manner that is capable of being described by an equation of motion that describes the acceleration that would result based on the user's applied force.

236. DE '082 discloses a structural support. DE '082 discloses a base supporting pedal shaft 1 and a brake disk 4. See, for example, the hatched area under pedal shaft in Figure 1, which illustrates how the base connects to the ergometer. Moreover, DE '082 teaches "an ***assembly*** for generating dynamic resistances to motion on an ergometer," which refers to assembling the ergometer on a base. DE '082, col. 1.

237. DE '082 discloses a user input member movably connected to the structural support for movement relative to the structural support to define a measured velocity that is measured during application of an input force to the input member by a user. DE '082 discloses a movable member, pedal shaft 1, mounted to the base. Figure 1 shows pedal shaft 1 connected to a brake disk 4, pedal arms 2 and pedals 3. The pedal shaft 1 and brake disk 2 define a velocity and receive an input force from the user applied to the pedals 3. DE '082, col. 2. DE '082 discloses a rotational speed sensor 7. *See* DE '082, Fig. 1 & col. 2 ("The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7."). The signals from the force and speed sensors are fed to a computer 8. DE '082, col. 2.

238. DE '082 discloses that the user input member defines a variable resistance force tending to resist movement due to input force applied by a user. DE '082 discloses a variable resistance force, a brake 5 that applies a braking force F. DE '082, cols. 2-3.

239. DE '082 discloses a control system that utilizes a velocity difference between the measured velocity and a virtual velocity as a control input to control the resistance force on the user input member. DE '082 discloses comparing the actual measured speed to the virtual rotational speed of the simulated flywheel. DE '082, col. 3 & claim 1. Specifically, DE '082

uses an equation to calculate a virtual velocity value, which it calls the rotational speed $n_s$ of the simulated flywheel over time. This virtual velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3, claim 1, & Fig. 2. This calculated velocity value corresponds to the rotational speed of the simulated flywheel, providing an estimate of the velocity of the flywheel that would occur during the physical activity if the user applied force had been applied to actual flywheel. DE ’082, col. 3 & claim 1. DE ’082 controls the braking force F based on the comparison of the actual measured speed to the virtual rotational speed of the simulated flywheel, so that the actual measured speed corresponds to the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 (“The brake 5 does not act again until the rotational speed, currently calculated in the computer, corresponds to the rotational speed measured at the brake disk.”); DE ’082, claim 1 (“the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer (8).”).

240. DE ’082 discloses that the control system is configured to continuously and rapidly recalculate the virtual velocity while an input force is being applied to the input member by a user. DE ’082 teaches “continuously” calculating the virtual rotational speed of the simulated flywheel and comparing it to the measured speed. DE ’082, col. 3; *see also* DE ’082, col. 2 (“Advantageously the moment of inertia of the simulated flywheel is continuously adjustable over a wide range.”).

241. DE ’082 discloses that the control system is configured to determine the virtual velocity, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force for the human physical activity being

simulated. DE ’082 discloses using an equation of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE ’082, col. 3 (“the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer.”). The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3.

242. DE ’082 discloses that the control system is configured to continuously and rapidly recalculate the velocity difference while an input force is being applied to the input member by a user such that the resistance force varies to simulate the changes in force experienced by a user due to changes in momentum of the human physical activity that is being simulated. DE ’082 teaches “continuously” calculating the virtual rotational speed of the simulated flywheel and comparing it to the measured speed. DE ’082, col. 3. The brake is varied based on this “continuous” comparison between the virtual rotational speed of the simulated flywheel and the measured speed. DE ’082, col. 3 (“The difference with respect to a real ergometer (according to the parameter settings) is continuously calculated in the computer 8; and the brake is adjusted accordingly.”).

243. Accordingly, it is my opinion that DE ’082 discloses every limitation of claim 1 of the ’476 patent and, therefore, anticipates claim 1 of the ’476 patent.

### 2. Claim 28 of the ’476 Patent

244. It is my opinion that DE ’082 anticipates claim 28 of the ’476 patent. Claim 28 recites:

> 28. An exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of

> being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity, the exercise device comprising:
>
> > a structural support;
> >
> > a user input member movably connected to the structural support for movement relative to the structural support to define a measured variable upon application of an input force to the input member by a user, and wherein the user input member defines a variable resistance force tending to resist movement due to input force applied by a user;
> >
> > a control system configured to utilize first and second values of the measured variable that are both measured while a user is applying an input force to the input member, and wherein the first value is measured before the second value, and wherein the control system is configured to determine a difference between the first value of the measured variable, and a first value of a virtual variable as a control input to control the resistance force on the user input member, wherein the control system is configured to determine the virtual variable, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force input by a human for the human physical activity being simulated, and wherein the control system is configured to utilize the first value of the measured variable as an input variable in the equation of motion such that the resistance force varies in a manner that simulates changes in force due to changes in momentum according to the equation of motion.

245. DE ’082 expressly discloses each limitation of this claim.

246. DE ’082 discloses an exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity. DE ’082 teaches a device and methods for “the real simulation of the load of cycling.” DE ’082, col. 2. DE ’082 teaches calculating “the internal rotational speed of the flywheel simulated in the computer” and controlling the resistance supplied by the brake until the actual measured speed equals the “the internal rotational speed of the flywheel simulated in

the computer." DE '082, claim 1. DE '082 discloses using an equation of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE '082, col. 3 ("the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer."); *see also* DE '082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE '082 simulates physical activity in a manner that is capable of being described by an equation of motion that describes the acceleration that would result based on the user's applied force.

247. DE '082 discloses a structural support. DE '082 discloses a base supporting pedal shaft 1 and a brake disk 4. See, for example, the hatched area under pedal shaft in Figure 1, which illustrates how the base connects to the ergometer. Moreover, DE '082 teaches "an ***assembly*** for generating dynamic resistances to motion on an ergometer," which refers to assembling the ergometer on a base. DE '082, col. 1.

248. DE '082 discloses a user input member movably connected to the structural support for movement relative to the structural support to define a measured variable upon application of an input force to the input member by a user. DE '082 discloses a movable member, pedal shaft 1, mounted to the base. Figure 1 shows pedal shaft 1 connected to a brake disk 4, pedal arms 2 and pedals 3. The pedal shaft 1 and brake disk 2 define a velocity and receive an input force from the user applied to the pedals 3. DE '082, col. 2. DE '082 discloses a rotational speed sensor 7. *See* DE '082, Fig. 1 & col. 2 ("The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7."). The signals from the force and speed sensors are fed to a computer 8. DE '082, col. 2.

249. DE '082 discloses that the user input member defines a variable resistance force tending to resist movement due to input force applied by a user. DE '082 discloses a variable resistance force, a brake 5 that applies a braking force F. DE '082, cols. 2-3.

250. DE '082 discloses a control system configured to utilize first and second values of the measured variable that are both measured while a user is applying an input force to the input member. DE '082 discloses a rotational speed sensor 7 that measures rotational speed of the brake disk. DE '802, col. 2-3. DE '082 discloses that the speed as measured by speed sensor 7 should be "continuously" monitored and is an input to a computer 8 that controls the resistance supplied by the brake. DE '802, col. 3. Because the speed is "continuously" monitored, there must necessarily be a first and second value of the speed as measured by the speed sensor.

251. DE '082 discloses that the first value is measured before the second value, and wherein the control system is configured to determine a difference between the first value of the measured variable, and a first value of a virtual variable as a control input to control the resistance force on the user input member. DE '802 discloses "continuously" comparing the actual speed as measured by speed sensor 7 to the virtual rotational speed of the simulated flywheel. DE '082, col. 3 & claim 1.

252. DE '082 discloses that the control system is configured to determine the virtual variable, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force input by a human for the human physical activity being simulated. DE '082 uses an equation to calculate the virtual rotational speed of the simulated flywheel, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This virtual velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE '082, col. 3, claim 1, & Fig. 2. This calculated velocity value

corresponds to the rotational speed of the simulated flywheel, providing an estimate of the velocity of the flywheel that would occur during the physical activity if the user applied force had been applied to actual flywheel. DE ’082, col. 3 & claim 1. DE ’082 controls the braking force F based on the comparison of the actual measured speed to the virtual rotational speed of the simulated flywheel, so that the actual measured speed corresponds to the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 (“The brake 5 does not act again until the rotational speed, currently calculated in the computer, corresponds to the rotational speed measured at the brake disk.”); DE ’082, claim 1 (“the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer (8).”).

253. DE ’082 discloses that the control system is configured to utilize the first value of the measured variable as an input variable in the equation of motion such that the resistance force varies in a manner that simulates changes in force due to changes in momentum according to the equation of motion. DE ’082 teaches “continuously” calculating the virtual rotational speed of the simulated flywheel and comparing it to the measured speed. DE ’082, col. 3. The brake is varied based on this “continuous” comparison between the virtual rotational speed of the simulated flywheel and the measured speed. DE ’082, col. 3 (“The difference with respect to a real ergometer (according to the parameter settings) is continuously calculated in the computer 8; and the brake is adjusted accordingly.”).

254. Accordingly, it is my opinion that DE ’082 discloses every limitation of claim 28 of the ’476 patent and, therefore, anticipates claim 28 of the ’476 patent.

### H. DE ’082 Anticipates or Renders Obvious the Asserted Dependent Claims of the ’476 Patent

255. Claim 2 of the ’476 Patent. Claim 2 recites: “The exercise device of claim 1, wherein: the control system includes a sensor that measures a variable associated with movement and the user input member from which a velocity of the user input member can be determined.” DE ’082 discloses this limitation. DE ’082 discloses a rotational speed sensor 7. *See* DE ’082, Fig. 1 & col. 2 (“The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7.”). The signals from the force and speed sensors are fed to a computer 8. DE ’082, col. 2.

256. Claim 3 of the ’476 Patent. Claim 3 recites: “The exercise device of claim 2, wherein: the control system includes a force-generating device that supplies the variable resistance force.” DE ’082 discloses this limitation. DE ’082 discloses Figure 1, which shows a force-generating device, brake 5, operably coupled to the movable member, pedal shaft 1, through the permanently attached brake disk 4. The brake 5 thereby applies a resistance force to the movable member. *See* DE ’082, col. 2 (“A brake 5 acts directly on the brake disk”). The Abstract of DE ’082 also states: “The breaking force of the break acts directly on the pedal shaft by means of a brake disk.” The brake is used to force the measured speed to equal the calculated or virtual speed of the simulated flywheel, which takes into account the effects of momentum.

257. Claim 6 of the ’476 Patent. Claim 6 recites: “The exercise device of claim 3, wherein: the control system includes a controller connected to the sensor and the force-generating device and sending a signal to the force-generating device based, at least in part, on a signal from the sensor.” DE ’082 discloses this limitation. The braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE ’082, col. 3 (“The moved, moment-loaded brake disk 4, the force and rotational

speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting control loop."). With respect to the force sensor, which is part of the "control and regulating device," col. 2, it is used to control the resistance supplied by the brake. The "rotational speed $n_s$ of the simulated damped flywheel" is calculated based, in part, on the user applied force as measured by the force sensor. This can be seen, for example, in Figure 2, where section II of the figure corresponds to the user being "inactive," or not applying any force to the pedals. As Figure 2 shows, the calculated rotational speed of the simulated flywheel, or $n_s$, decreases as a function of the user applied force—where the user applied force decreases, so too does the calculated rotational speed of the simulated flywheel. This is because the rotational speed of the simulated flywheel, or $n_s$, is calculated based in part on the user applied force. With respect to the speed sensor, DE '082 teaches that "the brake (5) does not respond again in accordance with the flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. That is, DE '082 adjusts the resistance of the brake so that the measured speed is equal to the calculated rotational speed of the simulated flywheel.

258. Claim 8 of the '476 Patent. Claim 8 recites: "The exercise device of claim 6, wherein: the controller updates the virtual velocity in a manner that takes into account the effects of momentum." DE '082 discloses this limitation. DE '082 discloses using an equation of motion that takes into account the effects of momentum—specifically, an equation that simulates the physical activity of a flywheel. DE '082, col. 3 ("the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer."). The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This corrected velocity value is based, at

least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

259. Claim 9 of the ’476 Patent. Claim 9 recites: “The exercise device of claim 8, wherein: the controller utilizes a linear relationship between acceleration and force to determine the effects of momentum.” DE ’082 discloses this limitation. As can be seen in Figure 2, as the user applies force, the calculated speed of the simulated flywheel, $n_s$, increases. In other words, as the user applied force to the pedals is increased, both the measured speed and the calculated speed of the simulated flywheel are also increased over time, *i.e.*, the acceleration increaases.

260. Claim 17 of the ’476 Patent. Claim 17 recites: “The exercise device of claim 1, wherein: the control system utilizes a measured force to determine the virtual velocity.” DE ’082 discloses this limitation. The calculated or virtual velocity of the simulated flywheel, called “the internal rotational speed of the flywheel simulated in the computer,” is calculated based, in part, on the user applied force as measured by a force sensor. DE ’082, claim 1; *see also* DE ’082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel).

261. Claim 18 of the ’476 Patent. Claim 18 recites: “The exercise device of claim 1, wherein: the control system is configured to vary the resistance force in a manner that tends to minimize the velocity difference.” DE ’082 discloses this limitation. DE ’082 teaches calculating “the internal rotational speed of the flywheel simulated in the computer” and

controlling the resistance supplied by the brake until the actual measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, col. 2 & claim 1.

262. Claim 19 of the '476 Patent. Claim 19 recites: "The exercise device of claim 1, wherein: the control system is configured to vary the resistance force in a manner that drives the velocity difference to a predetermined value." DE '082 discloses this limitation. DE '082 teaches calculating "the internal rotational speed of the flywheel simulated in the computer" and controlling the resistance supplied by the brake until the actual measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, col. 2 & claim 1.

**IX. It Would Have Been Obvious to Combine the '115 Patent with DE '082**

263. The '115 patent and DE '082 both relate to exercise devices that can be used to simulate physical activity by calculating a "virtual" or "target" velocity corresponding to the simulated physical activity based, at least in part, on the user applied forces. Both the '115 patent and DE '082 then control the resistance to the user based on a comparison between the "virtual" or "target" velocity and the actual measured velocity. Both are directed to the same problem and, for that reason, a person of ordinary skill would have looked at the teachings of both patents in combination.

264. In my opinion, the '115 patent anticipates all of the asserted claims and DE '082 anticipates all of the asserted claims except for claim 18 of the '865 patent and claim 2 of the '015 patent (which I believe are both still invalid as obvious, as I already discussed above). To the extent that the '115 patent is found not to disclose a claim limitation of any asserted claim (except for the limitations added by dependent claim 18 of the '865 patent or dependent claim 2 of the '015 patent), that claim would have an obvious combination of the '115 patent and DE '082. Conversely, to the extent that DE '082 is found not to disclose a claim limitation of any asserted claim, that claim would have an obvious combination of the '115 patent and DE '082. It

would have been obvious for a person of ordinary skill to combine the teachings of the '115 patent, which I discuss in this section, with the teachings of DE '082, which I discuss in the next section.

265. Below I describe a few exemplary combinations of the '115 patent and DE '082. I maintain, however, that it would have been obvious to combine the '115 patent and DE '082 with respect to all of the teachings I identified above.

266. Force Sensors. In my opinion, all of the asserted independent claims should be construed as requiring constant corrections to the velocity value based on the force applied by the user as measured by a force sensor. I believe that the '115 patent discloses the use of force sensors to measure the user applied force when it says "there is a means to measure the input torque at the pedals." Even if the '115 patent is read as not disclosing forces sensors, however, it would have been obvious to modify the exercise device of the '115 patent to include them. Force sensors were a known prior art element that yielded predictable results—a measurement of the applied force. The '115 patent specifically teaches that the user applied force *should* be measured. And a familiar and well-known way to measure the user applied force would have been a force sensor, as DE '082 teaches. Specifically, DE '082 discloses a force sensor 7 that measures the user applied force that is introduced to the brake disk. DE '082, col. 2; *see also* claim 1. Force sensors like those taught by DE '082 would have been one of a limited number of ways to predictably "measure the input torque at the pedals," which '115 patent teaches should be done.

267. Accordingly, in my opinion, it would have been obvious for a person of ordinary skill to combine the '115 patent with DE '082 patent and use force sensors to measure the user applied force. It would have been nothing more than the predictable user of prior art elements

according to their established functions. Moreover, the ’115 patent specifically says to measure the user applied force, and DE ’082 teaches that forces sensors were one predictable way to do so. Therefore, to the extent that any claim is not anticipated on the ground that the ’115 patent does not disclose a force sensor, that claim would have been obvious in my opinion.

268. Brake. Claim 9 of the ’015 patent and claim 7 of the ’964 patent both require that the resistance force be supplied by a brake. For the reasons I describe above, I believe that the ’115 patent discloses a brake and, therefore, anticipates thus claims. Even if the ’115 patent does not disclose a brake, it would have been obvious to combine the ’115 patent with DE ’082, which teaches that a brake is a predictable way to apply a resistance force. There only would have been a limited number of ways to apply a resistance force to the user, and a brake like that taught by DE ’082 would have been one predictable way to do so. The ’115 patent teaches that the resistance force can be supplied by “a DC motor, generator, alternator, hysteresis motor, eddy current devices, and the like ….” ’115 patent, col. 2:6-9. In my opinion, the term ‘eddy current devices” would be read to disclose an eddy current brake, as I discuss above. Even if not, however, DE ’082 teaches a “brake that is part of a control and regulating device” and that the “braking force of the brake acts directly on the pedal shaft by way of the brake disk.” DE ’082, col. 2; *see also* claim 1.

269. Accordingly, in my opinion, it would have been obvious for a person of ordinary skill to combine the ’115 patent with DE ’082 patent and a brake to resist the user applied force. It would have been nothing more than the predictable user of prior art elements according to their established functions. Moreover, the ’115 patent specifically says to resist the user applied force, and DE ’082 teaches that a brake connected to a control system was one predictable way to do so. Therefore, to the extent that claim 9 of the ’015 patent or claim 7 of the ’964 patent is not

anticipated on the ground that the ’115 patent does not disclose a brake connected to a control system, that claim would have been obvious in my opinion.

## X. U.S. Patent No. 6,066,074 and DE ’082 Render Obvious the Asserted Claims of the ’865, ’015, and ’964 Patents

270. U.S. Patent No. 6,066,074 issued from an application filed on July 13, 1998, and I understand that the ’074 patent is prior art as of that date under 35 U.S.C. § 102(e).

271. As I explain above, none of the asserted claims of the ’865, ’015, and ’964 patents are supported by the disclosure of the ’662 provisional application, which was filed on June 9, 1998. To the extent that the asserted claims of the ’865, ’015, and ’964 patents have any written-description support at all, it would have come no earlier than June 7, 1999, which is the date that the first non-provisional application was filed in in the ’865, ’015, or ’964 patent family. Accordingly, it is my opinion that the asserted claims of the ’865, ’015, and ’964 patent have a priority date of no earlier than June 7, 1999 and, therefore, that the ’074 patent is prior art to them.

272. The ’074 patent is directed to treadmills and other exercise machines that have a moveable surface upon which a user can exercise. The treadmills and exercise machines of the ’074 patent are “designed to simulate the motion of a travelling body.” ’074 patent, 1:13-14. Figure 1 shows one embodiment, which has a frame 10, a running platform 14, and a flexible revolving belt 20 that passes across the upper surface of the running platform 14.

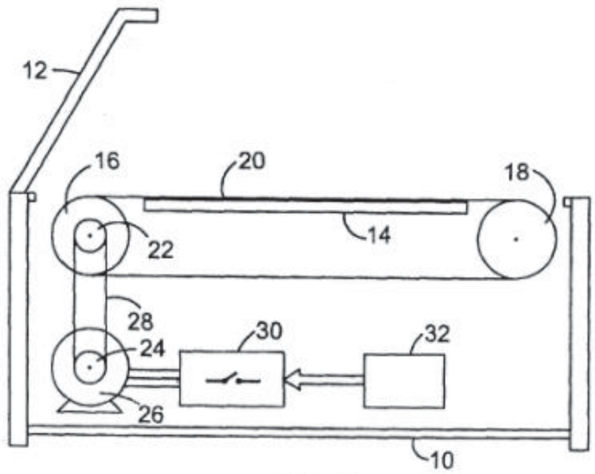



Fig 1

273. The ’074 patent teaches simulating “the motion of a traveling body” without the need for a flywheel. Instead of a flywheel, the ’074 patent uses a controller 32 that controls how much force a motor 26 applies to resist the movements of a user. ’074 patent, 5:23-25 (“The switch timing is effected by a controller 32 programmed to carry out a switching strategy that is designed to control the torque output of the motor with changes in the load.”). In other words, instead of using a flywheel, the ’074 patent simulates physical activity using a control system to vary the force supplied by a motor, which simulates the momentum of the human body in motion. ’074 patent, 1:26-28.

### A. Motivation to Simulate Physical Activity without a Flywheel

274. A person of ordinary skill in the art would have been motivated to pursue exercise devices that simulate physical without the use of a flywheel. Both the ’074 patent and DE ’082, as long as numerous other prior art references, teach the benefits of removing the flywheel. The ’074 patent states at 2:1-7:

> It is well known that flywheels, by their nature, are relatively heavy items and often of a size which makes them awkward to integrate into a housing for the other, significantly smaller, components that will be associated with powering a piece of exercise apparatus. The presence

> of the flywheel in an exercise apparatus of the type described may significantly increase the size of the unit overall.

275. As the ’074 patent teaches, replacing the flywheel with a control system to simulate physical activity produces “a reduction in cost, size and weight” of the device. ’074 patent, 12:38-39.

276. The ’074 patent also teaches that a person of ordinary skill would have been motivated to remove the flywheel in all types of exercise machines, not just treadmills. The ’074 patent stats at 12:40-49:

> It will be appreciated that this invention is applicable to other exercise apparatus in which the prior art flywheel has been used to maintain the motor speed substantially constant in the presence of sudden changes in load. Embodiments of the invention apply, for example, to rowing machines, where the flywheel simulates the inertia of the oars and/or the boat and/or the water displaced by the oars, and to exercise cycles, where the flywheel simulates the inertia of the user and a bicycle.

277. DE ’082 provides additional reasons for why a person of ordinary skill would have been motivated to remove the flywheel, saying that a simulated flywheel provides a better and more realistic simulation than an actual, physical flywheel. DE ’082, col. 2 (“Advantageously the moment of inertia of the simulated flywheel is continuously adjustable over a wide range.”). That the moment of inertia of a simulated flywheel is “continuously adjustable” means that it is better able to simulate the effects of momentum. Therefore, besides even reducing the cost, size and weight of the device, a person of ordinary skill also would have expected that removing the flywheel would result in a better, more realistic simulation of physical activity (*e.g.*, running in the case of a treadmill, or cycling in the case of a bike trainer).

### B. The ’074 Patent and DE ’082 Both Teach Predictable Solutions for Removing a Flywheel

278. The ’074 patent and DE ’082 both disclose predictable solutions to the known problem of how to remove a flywheel from an exercise device. A person of ordinary skill would

have recognized, as the ’074 patent and DE ’082 both teach, that the specific control system taught by the ’074 patent or DE ’082 could have been predictable implemented on any exercise device that used a conventional, physical flywheel. ’074 patent, 12:40-49; DE ’082, col. 1 (suggesting use of invention for “a spectrum of use [that] requires different devices with special load responses and programs,” including for “fitness training in the home and studio and in the medical sector for therapy, diagnosis, rehabilitation or defined stress”).

279. It would have been obvious to substitute the known, predictable control system of DE ’082 into the exercise machines of the ’074 patent, and vice versa. Both the ’074 patent and DE ’082 teach a control system that can predictably simulate a flywheel using only well-known parts like speed sensors, force sensors, and computers.

### C. The Combination of the ’074 Patent and DE ’082 Discloses Every Limitation of Independent Claim 16 of the ’865 Patent

280. The combination of the ’074 patent and DE ’082 discloses an apparatus for simulating forces and movement of a human subject during a physical activity. The ’074 patent teaches an “exercise apparatus designed to simulate the motion of a travelling body,” allowing “the user to simulate an exercise in the form of human-powered transport.” ’074 patent, 1:113-14, 16-18. Likewise, DE ’082 teaches a “Method and Assembly for Generating Dynamic Resistance to Motion on an Ergometer” (54). In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim term “simulating forces and movement of a human subject during a physical activity” should be construed as “making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass.” The combination of the ’074 patent and DE ’082 meets this definition. DE ’082 teaches calculating “the internal rotational speed of the flywheel simulated in the computer” and controlling the resistance

supplied by the brake until the actual measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. The "the internal rotational speed of the flywheel simulated in the computer" is calculated based, in part, on the user applied force as measured by a force sensor. DE '082, claim 1; *see also* DE '082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE '082 teaches correcting the velocity to match the simulated velocity, which is calculated in part based on the user applied force as measured by a force sensor. Even if a broader construction is used, however, the limitation is still taught be DE '082.

281. The combination of the '074 patent and DE '082 discloses a base. The '074 patent teaches a frame 10. '074 patent, 4:59-5:5.

282. The combination of the '074 patent and DE '082 discloses a movable member mounted to the base, the movable member defining a velocity and receiving an input force applied to the movable member by a human subject. The '074 patent teaches a revolving, flexible belt 20 that is looped around the rollers 16/18 passing across the upper surface of the platform 14. '074 patent, 4:59-5:5. The revolving belt 20 defines a velocity and receives an input force from the user, who runs on top of the revolving belt and thereby causes the revolving belt to move.

283. The combination of the '074 patent and DE '082 discloses a force-generating device operably coupled to the movable member and applying a resistance force to the movable member. Specifically, DE '082 teaches Figure 1, which shows a force-generating device, brake 5, operably coupled to the movable member, pedal shaft 1, through the permanently attached brake disk 4. The brake 5 thereby applies a resistance force to the movable member. *See* DE

’082, col. 2 (“A brake 5 acts directly on the brake disk”). The Abstract of DE ’082 also states: “The breaking force of the break acts directly on the pedal shaft by means of a brake disk.”

284. The combination of the ’074 patent and DE ’082 discloses a sensor configured to provide a signal corresponding to at least one of the velocity of the movable member and an input force applied to the movable member by a human subject. The ’074 patent teaches that a “rotor position/speed sensor is desirable.” ’074 patent, 6:10-12. Likewise, DE ’082 teaches both a force sensor and a speed sensor. First, DE ’082 teaches a force sensor 6. *See* DE ’082, Fig. 1 & col. 2 (“The force that is introduced to the brake disk 4 is measured by a force sensor 6. It is proportional to the moment introduced into the pedal shaft 1.”). Second, DE ’082 teaches a rotational speed sensor 7. *See* DE ’082, Fig. 1 & col. 2 (“The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7.”). The signals from the force and speed sensors are fed to a computer 8. DE ’082, col. 2.

285. The combination of the ’074 patent and DE ’082 discloses a controller configured to control the resistance force applied to the movable member by the force-generating device based, at least in part, on a signal provided by the sensor and a haptic equation incorporating an equation of motion of a human subject performing the physical activity being simulated. The ’074 patent discloses a controller, one of which is shown in Figure 7, that controls the force the motor applies to resist the user based on the user applied force and speed of the revolving belt. ’074 patent, 10:1-40. DE ’082 discloses a controller (computer 8) connected to the force generating device (brake 5), with input (signals) from a force sensor 6 and speed sensor 7. DE ’082 discloses a force generating device, a brake 5 that applies a braking force F. DE ’082, cols. 2-3. The braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE ’082, col. 3 (“The moved, moment-loaded

brake disk 4, the force and rotational speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting control loop."). With respect to the force sensor, which is part of the "control and regulating device," col. 2, it is used to control the resistance supplied by the brake. The "rotational speed $n_s$ of the simulated damped flywheel" is calculated based, in part, on the user applied force as measured by the force sensor. This can be seen, for example, in Figure 2, where section II of the figure corresponds to the user being "inactive," or not applying any force to the pedals. As Figure 2 shows, the calculated rotational speed of the simulated flywheel, or $n_s$, decreases as a function of the user applied force—where the user applied force decreases, so too does the calculated rotational speed of the simulated flywheel. This is because the rotational speed of the simulated flywheel, or $n_s$, is calculated based in part on the user applied force. With respect to the speed sensor, DE '082 teaches that "the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. That is, DE '082 adjusts the resistance of the brake so that the measured speed is equal to the calculated rotational speed of the simulated flywheel.

286. In my opinion, the term "haptic equation" is indefinite, as I describe below at § XII. To the extent that the term has any reasonably definite construction, DE '082 meets that definition. Based on the disclosure of the '865 patent, any reasonably definite construction of the term requires, at least, that a "haptic equation" be an "equation that provides a corrected velocity value based on the force applied by the user as measured by a force sensor." DE '082 discloses calculating a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. DE '082, col. 3. This corrected velocity value is based,

at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

287. Accordingly, it is my opinion that the ’074 patent and DE ’082 renders obvious claim 16 of the ’865 patent.

### D. The Combination of the ’074 Patent and DE ’082 Discloses Every Limitation of the Asserted Dependent Claims of the ’865 Patent

288. Claim 18 of the ’865 Patent. Claim 18 recites: “The apparatus of claim 16, wherein: the haptic equation relates the velocity to a time integral of the force.” DE ’082 relates the velocity to a time integral of the force (i.e., load on the person exercising). DE ’082, col. 2. Specifically, DE ’082 discloses at col. 2:

> The parameters that determine the breaking characteristics and the dynamics of the pedal shaft of the ergometer are preset in the computer 8 by means of an input 9. These parameters (moment of inertia of the flywheel, the damping of the flywheel friction, speed limit) are used to calculate the currently necessary braking force F which is fed by way of the breaking force intensifier 10 to the brake 5, as long as the person exercising is active. The parameters can be continuously changed and can determine the load on the person exercising.

289. This limitation recites nothing more than a general principle of physics—the “time integral of the force” is the same thing as the total work that the user applies to the system, which would necessarily influence the velocity. Just as a matter of simple logic—the more work that the user has applied to the device, the faster its speed. Claim 18 does nothing more than merely recite this well-known and predictable result, which is obvious as a matter of general physics. Therefore, even if DE ’082 did not disclose it, the limitation would have been obvious to a person of ordinary skill in the art.

290. Claim 20 of the ’865 Patent. Claim 20 recites: “The apparatus of claim 16, including: a restraint adapted to react a force applied by a human subject.” DE ’082 discloses a restraint (brake 5) that is adapted to react a force applied (via pedal 3 and pedal arm 4) by the user. *See also* DE ’082, claim 2.

291. Claim 21 of the ’865 Patent. Claim 21 recites: “The apparatus of claim 20, wherein: the sensor determines a force applied to the restraint.” DE ’082 discloses that the “force that is introduced to the brake disk 4 is measured by a force sensor 6.” DE ’082, col. 2.

292. Claim 24 of the ’865 Patent. Claim 24 recites: “The apparatus of claim 16, wherein: the controller calculates at least one of a target input force and a target velocity utilizing a haptic equation of motion and controls the force-generating device based on at least one of the target input force and a target velocity. In my opinion, the term “haptic equation” is indefinite, as I describe below at § XII. To the extent that the term is capable of any reasonably construction, DE ’082 discloses this limitation. Specifically, DE ’082 calculates a “rotational speed $n_s$ of the simulated damped flywheel,” which is a target velocity used to control the resistance supplied by the brake. The “rotational speed $n_s$ of the simulated damped flywheel” is calculated based, in part, on the user applied force as measured by the force sensor. The brake is varied based on a “continuous” comparison between the virtual rotational speed of the simulated flywheel and the measured speed. DE ’082, col. 3 (“The difference with respect to a real ergometer (according to the parameter settings) is continuously calculated in the computer 8; and the brake is adjusted accordingly.”).

## E. The Combination of the ’074 Patent and DE ’082 Discloses Every Limitation of Independent Claims 1 and 10 of the ’015 Patent

### 1. Claim 1 of the ’015 Patent

293. The combination of the ’074 patent and DE ’082 discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of the movable component to simulate the effects of changes in momentum that occur during the physical activity. In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim terms “providing a simulation of a corresponding physical activity involving human motion” and “simulate the effects of changes in momentum” should be construed as “making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass.” The combination of the ’074 patent and DE ’082 meet this definition. The ’074 patent teaches an “exercise apparatus designed to simulate the motion of a travelling body,” allowing “the user to simulate an exercise in the form of human-powered transport.” ’074 patent, 1:113-14, 16-18. Likewise, DE ’082 teaches calculating “the internal rotational speed of the flywheel simulated in the computer” and controlling the resistance supplied by the brake until the actual measured speed equals the “the internal rotational speed of the flywheel simulated in the computer.” DE ’082, claim 1. The “the internal rotational speed of the flywheel simulated in the computer” is calculated based, in part, on the user applied force as measured by a force sensor. DE ’082, claim 1; *see also* DE ’082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE ’082 teaches correcting the velocity to match the simulated velocity, which is calculated in part based

on the user applied force as measured by a force sensor. Even if a broader construction is used, however, the limitation is still taught be DE ’082.

294. The combination of the ’074 patent and DE ’082 discloses determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus, wherein the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity. DE ’082 teaches using an equation of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE ’082, col. 3 (“the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer.”). The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

295. The combination of the ’074 patent and DE ’082 discloses determining a value of a variable corresponding to at least one of a user’s mass, a velocity of the movable component of the exercise apparatus, and a force applied to a component of the exercise apparatus during use thereof. The ’074 patent teaches that a “rotor position/speed sensor is desirable.” ’074 patent, 6:10-12. Likewise, DE ’082 teaches both a force sensor and a speed sensor. First, DE ’082 discloses a force sensor 6 that measures the user applied force. *See* DE ’082, Fig. 1 & col. 2 (“The force that is introduced to the brake disk 4 is measured by a force sensor 6. It is

proportional to the moment introduced into the pedal shaft 1.”). Second, DE ’082 discloses a rotational speed sensor 7 that measures the velocity of the movable component of the exercise apparatus. *See* DE ’082, Fig. 1 & col. 2 (“The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7.”). The signals from the force and speed sensors are fed to a computer 8. DE ’082, col. 2.

296. The combination of the ’074 patent and DE ’082 discloses providing a controller. The ’074 patent teaches a controller 32, which is “a controller for controlling an output of the machine/” ’074 patent, 5:17-25 & claim 1. DE ’082 teaches a controller (computer 8) connected to the force generating device (brake 5), with input (signals) from a force sensor 6 and speed sensor 7.

297. The combination of the ’074 patent and DE ’082 discloses configuring the controller to control at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on a control parameter determined at least in part by the value of the variable and the equation of motion for the physical activity being simulated by the apparatus. DE ’082 discloses that the braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE ’082, col. 3 (“The moved, moment-loaded brake disk 4, the force and rotational speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting control loop.”). With respect to the force sensor, which is part of the “control and regulating device,” col. 2, it is used to control the resistance supplied by the brake. The “rotational speed $n_s$ of the simulated damped flywheel” is calculated based, in part, on the user applied force as measured by the force sensor. This can be seen, for example, in Figure 2, where section II of the figure corresponds to the user being “inactive,” or

not applying any force to the pedals. As Figure 2 shows, the calculated rotational speed of the simulated flywheel, or $n_s$, decreases as a function of the user applied force—where the user applied force decreases, so too does the calculated rotational speed of the simulated flywheel. This is because the rotational speed of the simulated flywheel, or $n_s$, is calculated based in part on the user applied force. With respect to the speed sensor, DE ’082 teaches that “the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer.” DE ’082, claim 1. That is, DE ’082 adjusts the resistance of the brake so that the speed measured by a speed sensor is equal to the calculated rotational speed of the simulated flywheel, which is calculated in part on the user applied force as measured by a force sensor.

298. Accordingly, it is my opinion that the ’074 patent and DE ’082 renders obvious claim 1 of the ’015 patent.

**2. Claim 10 of the ’015 Patent**

299. The combination of the ’074 patent and DE ’082 discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling the resistance of the movable component. In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim term “providing a simulation of a corresponding physical activity involving human motion” should be construed as “making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass.” The combination of the ’074 patent and DE ’082 meet this definition. The ’074 patent teaches an “exercise apparatus designed to simulate the motion of a travelling body,”

allowing "the user to simulate an exercise in the form of human-powered transport." '074 patent, 1:113-14, 16-18. Likewise, DE '082 teaches calculating "the internal rotational speed of the flywheel simulated in the computer" and controlling the resistance supplied by the brake until the actual measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. The "the internal rotational speed of the flywheel simulated in the computer" is calculated based, in part, on the user applied force as measured by a force sensor. DE '082, claim 1; *see also* DE '082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE '082 teaches correcting the velocity to match the simulated velocity, which is calculated in part based on the user applied force as measured by a force sensor. Even if a broader construction is used, however, the limitation is still taught be DE '082.

300. The combination of the '074 patent and DE '082 discloses determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus. DE '082 discloses using an equation of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE '082, col. 3 ("the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer."). The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE '082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

301. The combination of the ’074 patent and DE ’082 discloses measuring at least one of a velocity of the movable component of the exercise apparatus during use thereof, and a force applied to a component of the exercise apparatus during use thereof. The ’074 patent teaches that a “rotor position/speed sensor is desirable.” ’074 patent, 6:10-12. Likewise, DE ’082 teaches both a force sensor and a speed sensor. First, DE ’082 discloses a force sensor 6. *See* DE ’082, Fig. 1 & col. 2 (“The force that is introduced to the brake disk 4 is measured by a force sensor 6. It is proportional to the moment introduced into the pedal shaft 1.”). Second, DE ’082 discloses a rotational speed sensor 7. *See* DE ’082, Fig. 1 & col. 2 (“The rotational speed of the brake disk 4 is determined by means of a rotational speed sensor 7.”). The signals from the force and speed sensors are fed to a computer 8. DE ’082, col. 2.

302. The combination of the ’074 patent and DE ’082 discloses providing a controller. The ’074 patent teaches a controller 32, which is “a controller for controlling an output of the machine/” ’074 patent, 5:17-25 & claim 1. DE ’082 teaches a controller (computer 8) connected to the force generating device (brake 5), with input (signals) from a force sensor 6 and speed sensor 7.

303. The combination of the ’074 patent and DE ’082 discloses configuring the controller to control the resistance to movement of the at least one movable component based, at least in part, on the measured velocity or force and the equation of motion for the physical activity being simulated by the apparatus. DE ’082 discloses a force generating device, a brake 5 that applies a braking force F. DE ’082, cols. 2-3. The braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE ’082, col. 3 (“The moved, moment-loaded brake disk 4, the force and rotational speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting

control loop.”). With respect to the force sensor, which is part of the “control and regulating device,” col. 2, it is used to control the resistance supplied by the brake. The “rotational speed $n_s$ of the simulated damped flywheel” is calculated based, in part, on the user applied force as measured by the force sensor. This can be seen, for example, in Figure 2, where section II of the figure corresponds to the user being “inactive,” or not applying any force to the pedals. As Figure 2 shows, the calculated rotational speed of the simulated flywheel, or $n_s$, decreases as a function of the user applied force—where the user applied force decreases, so too does the calculated rotational speed of the simulated flywheel. This is because the rotational speed of the simulated flywheel, or $n_s$, is calculated based in part on the user applied force. With respect to the speed sensor, DE ’082 teaches that “the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer.” DE ’082, claim 1. That is, DE ’082 adjusts the resistance of the brake so that the measured speed is equal to the calculated rotational speed of the simulated flywheel.

304. Accordingly, it is my opinion that the ’074 patent and DE ’082 renders obvious claim 10 of the ’015 patent.

### F. Either the Combination of the ’074 Patent and DE ’082 or the ’074 Patent, DE ’082, and the ’115 Patent Discloses Every Limitation of the Asserted Dependent Claims of the ’015 Patent

305. Claim 2 of the ’015 Patent. Claim 2 recites: “The method of claim 1, wherein: the equation of motion includes a term corresponding to an incline angle of a hill involved in the physical activity being simulated; and the controller utilizes the incline angle to control the at least one movable component.” It would have been obvious to combine the ’074 patent and DE ’082 with the ’115 patent, which teaches this limitation. Specifically, the ’115 patent teaches that the “speed reference” equation can be used to “simulate[] tours over hills.” ’115 patent,

9:62-65; *see also* claim 5 ("The stationary exercise bicycle in accordance with claim 3 wherein said preset load torque comprises a varying series of simulated tours over hills."); 4:27-29 ('the actual load torque setting can slowly vary with time such as when simulating riding a bicycle up and down hills"). Specifically, the '115 patent teaches that the "load torque," or $T_1$ in the disclosed equation, can be adjusted to simulate the incline of a hill. '115 patent, 4:27-29; 9:62-65. The "speed servo" control means then "compares S to the input speed and adjusts the motor load torque to force the pedal speed to equal S." '115 patent, 2:14-43; *see also* 6:21-25.

306. DE '082 itself teaches that "[a]dvantageously the moment of inertia of the simulated flywheel is continuously adjustable over a wide range," and that therefore "the real simulation of the load of cycling be possible." DE '082, cols. 1-2. That is, DE '082 implies what the '115 patent makes explicit—that it can be used to simulate tours over hills. It would have been desirable for a person of ordinary skill to select this feature, because as both DE '082 and the '115 patent teach, it would have been desirable to closely simulate the real-world conditions of cycling. And a person of ordinary skill would have had a reasonable expectation of success, because following the known techniques and methods in the '115 patent would have predictably yielded the ability to simulate tours over hills.

307. <u>Claim 4 of the '015 Patent</u>. Claim 4 recites: "The method of claim 1, including: utilizing the equation of motion to determine a corresponding haptic equation including a measured velocity and an update velocity; and controlling the movable component based, at least in part, on the update velocity." In my opinion, the term "haptic equation" is indefinite, as I describe below at § XII. To the extent that the term has any reasonably definite construction, DE '082 meets that definition. Based on the disclosure of the '865 patent, any reasonably definite construction of the term requires, at least, that a "haptic equation" be an "equation that provides a

corrected velocity value based on the force applied by the user as measured by a force sensor." DE '082 discloses calculating a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. DE '082, col. 3. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE '082, col. 3. DE '082 discloses how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel. DE '082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force. DE '082 discloses that the breaking force F is controlled so that the calculated velocity value $n_s$ equals the measured rotational speed. DE '082, col. 3 & claim 1.

308. Claim 9 of the '015 Patent. Claim 9 recites: "The method of claim 1, wherein: the exercise apparatus includes a brake that varies the resistance to movement of the movable member; and the controller controls the brake." DE '082 discloses a brake 5 that applies a braking force F. DE '082, col. 3 and claim 1. The brake is controlled by a computer 8, which continuously calculates the rotational speed of the simulated flywheel and controls the brake so that the calculated velocity of the simulated flywheel equals the measured speed. DE '082, cols. 2-3 & claim 1.

### G. The Combination of the '074 Patent and DE '082 Discloses Every Limitation of Independent Claim 1 of the '964 Patent

309. The combination of the '074 patent and DE '082 discloses a method of controlling stationary exercise apparatus of the type having at least one movable component providing a simulation of a corresponding physical activity involving human motion, wherein the exercise apparatus is capable of controlling at least one of the movement and the resistance of the

movable component to simulate the effects of changes in momentum that occur during the physical activity being simulated. In my opinion, and for reasons I more fully explain in my expert report on non-infringement, the claim terms "providing a simulation of a corresponding physical activity involving human motion" and "simulate the effects of changes in momentum" should be construed as "making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass." The combination of the '074 patent and DE '082 meet this definition. The '074 patent teaches an "exercise apparatus designed to simulate the motion of a travelling body," allowing "the user to simulate an exercise in the form of human-powered transport." '074 patent, 1:113-14, 16-18. Likewise, DE '082 teaches calculating "the internal rotational speed of the flywheel simulated in the computer" and controlling the resistance supplied by the brake until the actual measured speed equals the "the internal rotational speed of the flywheel simulated in the computer." DE '082, claim 1. The "the internal rotational speed of the flywheel simulated in the computer" is calculated based, in part, on the user applied force as measured by a force sensor. DE '082, claim 1; *see also* DE '082, col. 3 (describing how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel). Accordingly, DE '082 teaches correcting the velocity to match the simulated velocity, which is calculated in part based on the user applied force as measured by a force sensor. Even if a broader construction is used, however, the limitation is still taught be DE '082.

310. The combination of the '074 patent and DE '082 discloses determining an applied force that is applied to a component of the exercise apparatus by a user during use thereof by measuring an operating parameter of the stationary exercise apparatus that is related to an applied force that is applied to a component of the exercise apparatus by a user during use

thereof. DE ’082 discloses a force sensor that measures the user applied force. *See* DE ’082, Fig. 1 & col. 2 (“The force that is introduced to the brake disk 4 is measured by a force sensor 6. It is proportional to the moment introduced into the pedal shaft 1.”).

311. The combination of the ’074 patent and DE ’082 discloses determining a virtual velocity of the physical activity being simulated, wherein the estimate of a target velocity comprises an estimate of a velocity that would occur during the physical activity being simulated if the applied force had been applied by a user during an actual physical activity. DE ’082 uses an equation to calculate a virtual velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This virtual velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE ’082, col. 3, claim 1, & Fig. 2. This calculated velocity value corresponds to the rotational speed of the simulated flywheel, providing an estimate of the velocity of the flywheel that would occur during the physical activity if the user applied force had been applied to actual flywheel. DE ’082, col. 3 & claim 1.

312. The combination of the ’074 patent and DE ’082 discloses comparing the actual velocity of the virtual velocity. DE ’082 discloses comparing the actual measured speed to the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 & claim 1.

313. The combination of the ’074 patent and DE ’082 discloses controlling at least one of the movement and the resistance to movement of the at least one movable component to simulate the effects of changes in momentum based, at least in part, on the comparison of the actual velocity to the virtual velocity. DE ’082 discloses controlling the braking force F based on the comparison of the actual measured speed to the virtual rotational speed of the simulated flywheel, so that the actual measured speed corresponds to the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 (“The brake 5 does not act again until the rotational speed,

currently calculated in the computer, corresponds to the rotational speed measured at the brake disk.”); DE ’082, claim 1 (“the brake (5) does not respond again in accordance with the damped flywheel to be simulated, until the rotational speed of the pedal shaft (1) corresponds to the internal rotational speed of the flywheel simulated in the computer (8).”).

314. Accordingly, it is my opinion that the ’074 patent and DE ’082 renders obvious claim 10 of the ’015 patent.

### H. The Combination of the ’074 Patent and DE ’082 Discloses Every Limitation of the Asserted Dependent Claims of the ’964 Patent

315. Claim 2 of the ’964 Patent. Claim 2 recites: “The method of claim 1, wherein: the resistance to movement of the at least one movable component is increased if the actual velocity is greater than the virtual velocity.” DE ’082 discloses increasing the braking force F where the measured speed is greater than the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 & claim 1.

316. Claim 3 of the ’964 Patent. Claim 3 recites: “The method of claim 1, wherein: the resistance to movement of the at least one movable component is decreased if the actual velocity is less than the virtual velocity.” DE ’082 discloses decreasing the braking force F where the measured speed is less than the virtual rotational speed of the simulated flywheel. DE ’082, col. 3 & claim 1.

317. Claim 4 of the ’964 Patent. Claim 4 recites: “The method of claim 1, wherein: the virtual velocity is determined utilizing an equation of motion for the corresponding physical activity involving human motion.” DE ’082 discloses using an equation of motion that simulates a physical activity involving human motion—specifically, an equation that simulates the physical activity of a flywheel. DE ’082, col. 3 (“the rotational speed $n_S$ of the simulated damped flywheel over time … is calculated, as a function of the set parameters, in the computer.”). The

equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. This corrected velocity value is based, at least in part, on the user applied force as measured by a force sensor 6. DE '082, col. 3.

318. Claim 5 of the '964 Patent. Claim 5 recites: "The method of claim 4, wherein: the equation of motion includes at least one term that accounts for changes in momentum and a corresponding force experienced by a human during the physical activity." The equation calculates a corrected velocity value, which it calls the rotational speed $n_s$ of the simulated damped flywheel over time. DE '082 calculates a corrected velocity value based, at least in part, on the user applied force as measured by a force sensor 6. DE '082, col. 3. DE '082 discloses how the force and speed sensors are monitored are part of the continuous calculation of the simulated speed of the flywheel. DE '082, col. 3. As described above, this is shown in section II of Figure 2, which illustrates what happens to the calculated velocity value $n_s$ when the user is inactive, or not applying any force to the pedals. In that situation, the calculated velocity value $n_s$ decreases based on, at least in part, the decreased user applied force.

319. Claim 6 of the '964 Patent. Claim 6 recites: "The method of claim 1, wherein: the steps of determining a virtual velocity, determining an actual velocity, and comparing the actual velocity to the virtual velocity occur at a rate of at least ten times per second." DE '082 teaches "continuously" calculating the virtual rotational speed of the simulated flywheel and comparing it to the measured speed. DE '082, col. 3; *see also* DE '082, col. 2 ("Advantageously the moment of inertia of the simulated flywheel is continuously adjustable over a wide range."). A person of ordinary skill would read the term "continuously" as requiring calculations that occur far more often than the claimed ten times per second. For example, the '115 patent uses the term "continuously" to refer to a rate of every ten milliseconds, which is an order of

magnitude more frequent than required by claim 7 of the ’964 patent. ’115 patent, 8:18-30 & 7:29-32. Even if a person of ordinary skill did not read the term “continuously” in DE ’082 as teaching a rate of at least ten times per second, it would have been obvious to do so. Specifically, it would have been obvious to combine DE ’082 with the teaching in the ’115 patent to calculate the virtual velocity and compare it to the measured velocity at least every 10 milliseconds. As both DE ’802 and the ’115 patent teach, “continuous” calculations are preferable, because it provides a better simulation. ’115 patent, 8:18-30 & 7:29-32; DE ’082, col. 2-3. And a person of ordinary skill would have had a reasonable expectation of success, because performing these calculations at a rate of at least ten times per second was a known technique in the prior art that predictably yielded better simulations. ’115 patent, 8:18-30 & 7:29-32.

320. Claim 7 of the ’964 Patent. Claim 7 recites: “The method of claim 1, wherein: the stationary exercise apparatus includes a brake that selectively increases resistance of the movable component upon actuation of the brake, and including: selectively actuating the brake to control resistance to movement of the one movable component.” DE ’082 discloses that the braking force is controlled based, at least in part, on both the signal from the force sensor and the signal from the speed sensor. DE ’082, col. 3 (“The moved, moment-loaded brake disk 4, the force and rotational speed sensors 6 and 7, the computer 8 with input 9 and the brake 5 with braking force intensifier 10 form a fast acting control loop.”). That is, DE ’082 adjusts the resistance of the brake so that the speed measured by a speed sensor is equal to the calculated rotational speed of the simulated flywheel, which is calculated in part on the user applied force as measured by a force sensor.

## XI. U.S. Patent Publ. No. 2004/0116253 Anticipates or Renders Obvious the Asserted Claims of the '476 Patent

321. U.S. Patent Publ. No. 2004/0116253, or the '253 publication, was published on June 17, 2004, which is more than one year before the priority date of the '476 patent. Accordingly, the '253 publication is prior art to the '476 patent.

322. The '253 publication shares the same specification as the '865, '015, and '964 patents. It is the publication of the patent application that later issued as the '865 patent. The '476 patent does not claim priority to the '253 publication, or indeed any application in the same patent family as the '865, '015, and '964 patents.

323. In my opinion, the disclosure of the '253 publication—which is the same disclosure as the '865, '015, and '964 patents—anticipates every claim of the '476 patent. The '476 patent does make any novel contribution over the earlier disclosure of the '253 publication.

### A. The '253 Publication Anticipates Independent Claims 1 and 28 of the '476 Patent

#### 1. Claim 1 of the '476 Patent

324. It is my opinion that the '253 publication anticipates claim 1 of the '476 patent. Claim 1 recites:

> 1. An exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity, the exercise device comprising:
>
> a structural support;
>
> a user input member movably connected to the structural support for movement relative to the structural support to define a measured velocity that is measured during application of an input force to the input member by a user, and wherein the user input member defines a variable resistance force tending to resist movement due to input force applied by a user;

> a control system that utilizes a velocity difference between the measured velocity and a virtual velocity as a control input to control the resistance force on the user input member, wherein the control system is configured to continuously and rapidly recalculate the virtual velocity while an input force is being applied to the input member by a user, and wherein the control system is configured to determine the virtual velocity, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force for the human physical activity being simulated and wherein the control system is configured to continuously and rapidly recalculate the velocity difference while an input force is being applied to the input member by a user such that the resistance force varies to simulate the changes in force experienced by a user due to changes in momentum of the human physical activity that is being simulated.

325. The '253 publication expressly discloses each limitation of this claim.

326. The '253 publication discloses an exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity. The '253 publication repeatedly discloses simulating a human physical activity where a human applied force to an object that results in acceleration of the object in a manner that can be described by an equation of motion. For example, ¶ 203 and accompanying Figs. 2A and 2B disclose numerous types of physical activity involving user-applied force and "whether the velocity is maintained at a constant value or is non-constant, the direction of bipedal locomotion, the type of harnessing used, the applicable equation of motion, the input variables, the calculated variables, the measured data, and the calculated data for each mode of operation." *See also* Equations 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.6.1, 3.6.2, 3.7.1, 3.7.2; ¶¶ 198-99, 267-69.

327. The '253 publication discloses a structural support. *See for example* '253 publication, ¶ 145-46.

328. The ’253 publication discloses a user input member movably connected to the structural support for movement relative to the structural support to define a measured velocity that is measured during application of an input force to the input member by a user, and wherein the user input member defines a variable resistance force tending to resist movement due to input force applied by a user. As one of many examples, claim 21 recites a “movable member mounted to the base, the movable member defining a velocity and receiving a force applied to the movable member by a human subject.” As another example, ¶ 105 discloses a “movable member mounted to the base, the movable member defining a velocity and receiving a force applied to the movable member by a human subject.”

329. The ’253 publication discloses a control system that utilizes a velocity difference between the measured velocity and a virtual velocity as a control input to control the resistance force on the user input member. *See* ’253 publication, ¶ 270-77. David Blau, one of the inventors on the ’476 patent, even admitted it. *See* Blau Deposition Transcript, 191:23-192:

> **Q:** Isn’t paragraph 270 of [the ’253 publication] describing a control system that utilizes a velocity difference between the measured velocity and a virtual velocity as a control input?
>
> **A:** Yes, it is.

330. The disclosed process begins with calculating a “target velocity $V_{set}$” by “using the appropriate haptic equation.” ’253 publication, ¶ 268, 272. The target velocity, or $V_{set}$, is compared to “the actual velocity V.” ’253 publication, ¶ 273. If the target velocity $V_{set}$ is greater than the velocity V, then the velocity V must be increased, and “the resistance applied by the brake to the belt is reduced to allow the velocity V to increase.” ’253 publication, ¶ 273 (internal citations omitted). On the other hand, if the target velocity $V_{set}$ is less than the actual velocity V, then the velocity V must be decreased, and “the power to the brake is increased so

that the brake applies more friction and velocity V of the belt is reduced." '253 publication, ¶ 274 (internal citations omitted).

331. The '253 publication discloses that the control system is configured to continuously and rapidly recalculate the virtual velocity while an input force is being applied to the input member by a user. The '253 publication discloses obtaining a new force from the force sensor "at least every tenth of a second, more preferably every one-hundredth of a second, more preferably every one-thousandth of a second, and still more preferably every ten-thousandth of a second." '253 publication, ¶ 270. Every time a new force is obtained, "then a new value of the target velocity V(update) is calculated according to the appropriate iterative haptic equation." '253 publication, ¶ 269; Fig. 5C. Accordingly, the '253 publication teaches updating the virtual velocity every ten-thousandth of a second.

332. The '253 publication discloses that the control system is configured to determine the virtual velocity, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force for the human physical activity being simulated. The '253 publication discloses numerous equations of motion that can be used to calculate a virtual velocity. For example, Figs. 2A and 2B describe nine modes of operation, each with its own disclosed equation of motion, and all but one of those modes utilize the acceleration of the user. *See* Figs. 2A & 2B (columns I, II, IV-IX).

333. The '253 publication discloses that the control system is configured to continuously and rapidly recalculate the velocity difference while an input force is being applied to the input member by a user such. The '253 publication teaches obtaining a new force from the force sensor "every ten-thousandth of a second." '253 publication, ¶ 270. Every time a new force is obtained, "then a new value of the target velocity V(update) is calculated according to

the appropriate iterative haptic equation." '253 publication, ¶ 269; Fig. 5B. The '253 publication also teaches that the calculated virtual velocity should be compared to the actual velocity preferably as many as 50 times for each update of the measured force, which would be a comparison of the calculated virtual velocity to the actual velocity at least 50 times every ten-thousandth of a second. '253 publication, ¶ 270 ("the motor controller process … of FIG. 5C completes at least three, more preferably at least five, still more preferably at least ten, and still more preferably at least twenty, and still more preferably at least fifty velocity increments … of the actual velocity V towards the target velocity V(update) for each update of the monitored force F"). As the '253 publication discloses, "the more frequently the velocity V is incremented … towards the target velocity V(update) for each monitored value of the actual force F, the smaller the increments in the velocity V need to be, and the actual velocity V can more accurately match the target velocity V(update)." '253 publication, ¶ 270.

334. The '253 publication discloses that the resistance force varies to simulate the changes in force experienced by a user due to changes in momentum of the human physical activity that is being simulated. The '253 publication teaches varying the resistance force based on the comparison of the calculated virtual velocity to the actual measured velocity. If the virtual velocity, or target velocity $V_{set}$, is greater than the velocity V, then the velocity V must be increased, and "the resistance applied by the brake to the belt is reduced to allow the velocity V to increase." '253 publication, ¶ 273 (internal citations omitted). On the other hand, if the virtual, or target velocity $V_{set}$, is less than the actual velocity V, then the velocity V must be decreased, and "the power to the brake is increased so that the brake applies more friction and velocity V of the belt is reduced." '253 publication, ¶ 274 (internal citations omitted).

335. Accordingly, it is my opinion that the '253 publication discloses every limitation of claim 1 of the '476 patent and, therefore, anticipates claim 1 of the '476 patent.

### 2. Claim 28 of the '476 Patent

336. It is my opinion that the '253 publication anticipates claim 28 of the '476 patent. Claim 28 recites:

> 28. An exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity, the exercise device comprising:
>
> a structural support;
>
> a user input member movably connected to the structural support for movement relative to the structural support to define a measured variable upon application of an input force to the input member by a user, and wherein the user input member defines a variable resistance force tending to resist movement due to input force applied by a user;
>
> a control system configured to utilize first and second values of the measured variable that are both measured while a user is applying an input force to the input member, and wherein the first value is measured before the second value, and wherein the control system is configured to determine a difference between the first value of the measured variable, and a first value of a virtual variable as a control input to control the resistance force on the user input member, wherein the control system is configured to determine the virtual variable, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force input by a human for the human physical activity being simulated, and wherein the control system is configured to utilize the first value of the measured variable as an input variable in the equation of motion such that the resistance force varies in a manner that simulates changes in force due to changes in momentum according to the equation of motion.

337. The '253 publication expressly discloses each limitation of this claim.

338. The '253 publication discloses an exercise device for simulating a human physical activity of the type involving an application of a human input force to an object resulting in acceleration of the object in a manner that is capable of being described by an equation of motion

of the type that describes the acceleration of a mass under an influence of a force generated by a human in performing the activity. The ’253 publication repeatedly discloses simulating a human physical activity where a human applied force to an object that results in acceleration of the object in a manner that can be described by an equation of motion. For example, ¶ 203 and accompanying Figs. 2A and 2B disclose numerous types of physical activity involving user-applied force and “whether the velocity is maintained at a constant value or is non-constant, the direction of bipedal locomotion, the type of harnessing used, the applicable equation of motion, the input variables, the calculated variables, the measured data, and the calculated data for each mode of operation.” *See also* Equations 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.6.1, 3.6.2, 3.7.1, 3.7.2; ¶¶ 198-99, 267-69.

339. The ’253 publication discloses a structural support. *See* for example ’253 publication, ¶ 145-46.

340. The ’253 publication discloses a user input member movably connected to the structural support for movement relative to the structural support to define a measured variable upon application of an input force to the input member by a user. As one of many examples, claim 21 recites a “movable member mounted to the base, the movable member defining a velocity and receiving a force applied to the movable member by a human subject.” As another example, ¶ 105 discloses a “movable member mounted to the base, the movable member defining a velocity and receiving a force applied to the movable member by a human subject.”

341. The ’253 publication discloses that the user input member defines a variable resistance force tending to resist movement due to input force applied by a user. The ’253 publication discloses a motor or brake that is used to resist the user’s movement. As the Abstract says, the “velocity of the belt may be controlled by a motor and brake system, where the motor

may be uni-directional or bi-directional" and a "digital processor may be used to control the motor and/or brake as a function of the applied forces to simulate real-world or virtual world environment." In ¶ 273-78, the '253 publication describes how to control the resistance supplied by the motor or brake for modes of operation which simulate real-world or virtual-world scenarios.

342. The '253 publication discloses a control system configured to utilize first and second values of the measured variable that are both measured while a user is applying an input force to the input member. The '253 patent discloses "constant[ly]" measuring the velocity, which results in taking at least a first and second measreument of the velocity. '253 publication, ¶ 276, 270. Specifically, the '253 patent discloses comparing the measured velocity to the calculated "virtual" velocity at least 50 times for each update of the monitored force, and that the force should be monitored every ten-thousandth of a second. '253 publication, ¶ 270; *see also* Fig. 5C (in step 1835, the measured velocity V is rapidly and continuously incremented towards the "virtual" velocity).

343. The '253 publication discloses that the first value is measured before the second value, and wherein the control system is configured to determine a difference between the first value of the measured variable, and a first value of a virtual variable as a control input to control the resistance force on the user input member. The '253 patent teaches measuring the velocity up to 50 times every ten-thousandth of a second, *see* ¶ 267. In that frequent measuring of velocity, one velocity will necessary be measured before a second. The target velocity $V_{set}$, or "virtual" velocity, is a virtual variable that is a calculated variable based, in part, on the user applied force. '253 publication, ¶ 268 ("the force value F is new and so a new target velocity V(update) is calculated using the appropriate haptic equation"). The first measured velocity is

compared to a calculated "virtual" velocity. '253 publication, ¶ 272 ("The process begins with the reception of the target velocity $V_{set}$ [or "virtual" velocity] from the CPU and the reception of the actual velocity V from the velocity sensor."). The resistance supplied by the brake or motor is controlled based on the comparison of the measured velocity to the calculated target velocity $V_{set}$ or "virtual" velocity. If the target velocity $V_{set}$ is greater than the velocity V, then the velocity V must be increased, and "the resistance applied by the brake to the belt is reduced to allow the velocity V to increase." '253 publication, ¶ 273 (internal citations omitted). On the other hand, if the target velocity $V_{set}$ is less than the actual velocity V, then the velocity V must be decreased, and "the power to the brake is increased so that the brake applies more friction and velocity V of the belt is reduced." '253 publication, ¶ 274 (internal citations omitted).

344. The '253 publication discloses that the control system is configured to determine the virtual variable, at least in part, utilizing an equation of motion of the type that describes the acceleration of a mass under an influence of a force input by a human for the human physical activity being simulated. The '253 publication discloses numerous equations of motion that can be used to calculate a virtual velocity. For example, Figs. 2A and 2B describe nine modes of operation, each with its own disclosed equation of motion, and all but one of those modes utilize the acceleration of the user. *See* Figs. 2A & 2B (columns I, II, IV-IX).

345. The '253 publication discloses that the control system is configured to utilize the first value of the measured variable as an input variable in the equation of motion such that the resistance force varies in a manner that simulates changes in force due to changes in momentum according to the equation of motion. The '253 publication teaches varying the resistance force based on the comparison of the calculated virtual velocity to the actual measured velocity. If the virtual velocity, or target velocity $V_{set}$, is greater than the velocity V, then the velocity V

must be increased, and "the resistance applied by the brake to the belt is reduced to allow the velocity V to increase." '253 publication, ¶ 273 (internal citations omitted). On the other hand, if the virtual, or target velocity $V_{set}$, is less than the actual velocity V, then the velocity V must be decreased, and "the power to the brake is increased so that the brake applies more friction and velocity V of the belt is reduced." '253 publication, ¶ 274 (internal citations omitted).

346. Accordingly, it is my opinion that the '253 publication discloses every limitation of claim 28 of the '476 patent and, therefore, anticipates claim 28 of the '476 patent.

### B. The '253 Publication Anticipates the Asserted Dependent Claims of the '476 Patent

347. Claim 2 of the '476 Patent. Claim 2 recites: "The exercise device of claim 1, wherein: the control system includes a sensor that measures a variable associated with movement and the user input member from which a velocity of the user input member can be determined." The '253 publication discloses this limitation. Specifically, the '253 publication teaches measuring the velocity of the user input member. For example, ¶ 267 describes how: "The process begins with the reception of the target velocity $V_{set}$ from the CPU and the reception of the actual velocity V from the velocity sensor."

348. Claim 3 of the '476 Patent. Claim 3 recites: "The exercise device of claim 2, wherein: the control system includes a force-generating device that supplies the variable resistance force." The '253 publication discloses this limitation. Specifically, the '253 publication teaches a motor or brake that is used to resist the user's movement. As the Abstract says, the "velocity of the belt may be controlled by a motor and brake system, where the motor may be uni-directional or bi-directional" and a "digital processor may be used to control the motor and/or brake as a function of the applied forces to simulate real-world or virtual world environment." In ¶¶ 273-78, the '253 publication describes how to control the resistance

supplied by the motor or brake for modes of operation which simulate real-world or virtual-world scenarios.

349. Claim 6 of the ’476 Patent. Claim 6 recites: “The exercise device of claim 3, wherein: the control system includes a controller connected to the sensor and the force-generating device and sending a signal to the force-generating device based, at least in part, on a signal from the sensor.” The ’253 publication discloses this limitation. Specifically, the ’253 publication teaches that the control system is connected to both the velocity sensor and the motor or brake and sends a signal to the motor or brake based, at least in part, on the velocity as measured by the velocity sensor. ’253 publication, ¶¶ 267-74. The measured velocity is compared to a calculated “virtual” velocity. ’253 publication, ¶ 272 (“The process begins with the reception of the target velocity $V_{set}$ [or “virtual” velocity] from the CPU and the reception of the actual velocity V from the velocity sensor.”). The resistance supplied by the brake or motor is controlled based on the comparison of the measured velocity to the calculated target velocity $V_{set}$ or “virtual” velocity. If the target velocity $V_{set}$ is greater than the velocity V, then the velocity V must be increased, and “the resistance applied by the brake to the belt is reduced to allow the velocity V to increase.” ’253 publication, ¶ 273 (internal citations omitted). On the other hand, if the target velocity $V_{set}$ is less than the actual velocity V, then the velocity V must be decreased, and “the power to the brake is increased so that the brake applies more friction and velocity V of the belt is reduced.” ’253 publication, ¶ 274 (internal citations omitted).

350. Claim 8 of the ’476 Patent. Claim 8 recites: “The exercise device of claim 6, wherein: the controller updates the virtual velocity in a manner that takes into account the effects of momentum.” The ’253 publication discloses this limitation. Specifically, the ’253 publication repeatedly discloses simulating a human physical activity where a human applied force to an

object that results in acceleration of the object in a manner that can be described by an equation of motion. For example, ¶ 203 and accompanying Figs. 2A and 2B disclose numerous types of physical activity involving user-applied force and "whether the velocity is maintained at a constant value or is non-constant, the direction of bipedal locomotion, the type of harnessing used, the applicable equation of motion, the input variables, the calculated variables, the measured data, and the calculated data for each mode of operation." *See also* Equations 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.6.1, 3.6.2, 3.7.1, 3.7.2; ¶¶ 198-99, 267-69. The '253 publication discloses numerous equations of motion that can be used to calculate a virtual velocity. For example, Figs. 2A and 2B describe nine modes of operation, each with its own disclosed equation of motion, and all but one of those modes utilize the acceleration of the user. *See* Figs. 2A & 2B (columns I, II, IV-IX).

351. Claim 9 of the '476 Patent. Claim 9 recites: "The exercise device of claim 8, wherein: the controller utilizes a linear relationship between acceleration and force to determine the effects of momentum." The '253 publication discloses this limitation. Specifically, the '253 publication derives its equations from "well known" "Newtonian mechanics," where there is a known linear relationship between acceleration and force. *See* Equation 1.1 of the '253 publication.

352. Claim 17 of the '476 Patent. Claim 17 recites: "The exercise device of claim 1, wherein: the control system utilizes a measured force to determine the virtual velocity." The '253 publication discloses this limitation. Specifically, the '253 publication requires that, to simulate a real- or virtual-world environment, the calculated virtual velocity is based on a user applied force as measured by a force sensor. '253 patent, ¶¶ 198-99, 209, 267-68.

353. Claim 18 of the ’476 Patent. Claim 18 recites: “The exercise device of claim 1, wherein: the control system is configured to vary the resistance force in a manner that tends to minimize the velocity difference.” The ’253 publication discloses this limitation. Specifically, the ’253 publication teaches that: “the more frequently the velocity V is incremented towards the target velocity V(update) for each monitored value of the actual force F, the smaller the increments in the velocity V need to be, and the actual velocity V can more accurately match the target velocity V(update).” ’253 publication, ¶ 270; *see also* ¶¶ 273-74 (teaching how to adjust the resistance supplied by the motor or brake so that the difference between the virtual velocity and actual velocity is minimized); Fig. 5C. (describing process of “Increment[ing] V Towards $V_{(update)}$”); Fig. 5B.

354. Claim 19 of the ’476 Patent. Claim 19 recites: “The exercise device of claim 1, wherein: the control system is configured to vary the resistance force in a manner that drives the velocity difference to a predetermined value.” The ’253 publication discloses this limitation. Specifically, the ’253 publication teaches that: “the more frequently the velocity V is incremented towards the target velocity V(update) for each monitored value of the actual force F, the smaller the increments in the velocity V need to be, and the actual velocity V can more accurately match the target velocity V(update).” ’253 publication, ¶ 270; *see also* ¶¶ 273-74 (teaching how to adjust the resistance supplied by the motor or brake so that the difference between the virtual velocity and actual velocity is minimized); Fig. 5C. (describing process of “Increment[ing] V Towards $V_{(update)}$”); Fig. 5B.

## XII. The Term “Haptic Equation” Is Indefinite Under 35 U.S.C. § 112

355. As used in claims 16-24 of the ’865 patent, and claim 4 of the ’015 patent, the term “haptic equation,” viewed in light of the specification and prosecution history, fails to

inform those skilled in the art about the scope of the invention with reasonable certainty. Those claims are, therefore, invalid as indefinite under 35 U.S.C. § 112, ¶ 2 (2006).

356. I understand that patent claims are construed, or interpreted, as they would be understood by one of ordinary skill in the art of the patent at the time the patent application was filed. I understand that claim construction begins with looking at the language of the claim. I also understand that, beyond the claim language, the specification is considered the best guide to the meaning of a claim term. I also understand that claims are to be construed with reference to the intrinsic evidence in the specification and prosecution history, and extrinsic evidence, such as dictionaries and treatises.

357. I understand that a claim is indefinite if, read in light of the specification and the prosecution history, it fails to inform, with reasonable certainty, those skilled in the art about the scope of the invention. I also understand that simply because some claim language may not be precise does not automatically render a claim invalid.

358. In my opinion, a person of ordinary skill would not be able to determine with reasonable certainty the boundary of what is included within the phrase "haptic equation" based on the disclosure in the '865 patent. In fact, the '865 patent itself seems unsure about the scope of the term, alternatively and conflictingly calling the same operations "haptic" in some parts of the specification and "non-haptic" in others. For example, the specification calls the "forward-constant load mode" a "non-haptic" mode, *see* '865 patent, 33:27-28, but then elsewhere calls that same mode "haptic," *see* '865 patent, 39:46-47. The specification has the same confusing inconsistency with respect to the "backward constant-load mode" (also sometimes referred to as the "reverse constant-load" mode), describing it as both "non-haptic" and "haptic." *See* '865 patent, 33:26-29 (calling it "non-haptic"); '865 patent, 40:56 (calling it "haptic").

359. The term "haptic equation" has no customary or plain meaning to a person of ordinary skill. Although the basic or dictionary definition of haptic is broad—*i.e.*, "relating to or based on the sense of touch"—this does not provide any basis for distinguishing "haptic" equations from "non-haptic" ones. All exercise devices, in some way, relate to or are based on touch, specifically the user touching, or applying force to, the exercise device. Yet the '865 patent makes clear that there are "non-haptic" exercise devices too. '865 patent, 33:26-30 ("the exercise apparatus of the present invention can also operate in non-haptic modes…."). In those "non-haptic" modes of operation, the user still touches, or applies force to, the exercise device. '865 patent, Fig. 2B (a chart of the disclosed non-haptic modes, all of which require that the user apply force to the exercise device). Therefore, the term "haptic," as used by the '865 patent, cannot just mean "relating to or based on the sense of touch," because even the disclosed *non-haptic* modes relate to touch.

360. The specification confuses, rather than clarifies, the scope of the term. Nowhere does the specification provide a definition of the term. Instead, the specification distinguishes haptic modes from non-haptic ones without providing any reasonable basis for that distinction. The specification discloses five modes it calls haptic and four modes it calls non-haptic. '865 patent, 33:20-39. But the specification does not inform a person of ordinary skill why it classifies the first five modes as haptic and the other four as non-haptic. And even more confusingly, the specification contradicts itself by saying that two of the modes it initially called "non-haptic" are actually "haptic." '865 patent, 33:26-29 (calling the forward constant-load and backward constant-load modes "non-haptic"); '865 patent, 39:46-47 (contradicting itself with respect to the forward constant-load mode, now calling it "haptic"); '865 patent, 40:56 (contradicting itself with respect to the backward or reverse constant-load mode, now calling it

"haptic"). A person of ordinary skill, reading the specification of the '865 patent, would not be able to distinguish a haptic mode from a non-haptic one with any reasonable level of certainty.

361. The specification has additional—and similarly incomplete and inadequate—descriptions of the term, which further confuse its scope. The specification, in one place, seems to equate "haptic" with the simulation of a real-world or virtual-world environment. Specifically, the specification says, "haptic modes of operation, i.e., modes of operation which simulate a real-world or virtual-world environment …." '865 patent, 32:17-18. The first problem with that description, however, is that the phrase "simulate a real-world or virtual-world environment" is itself so ambiguous as to be meaningless. It merely lists a hoped-for property—simulating a real-world or virtual-world environment—without describing how to achieve that property. It also does not provide any guidance on what it means to "simulate" a real- or virtual-world environment, *i.e.*, how close an approximation is required for it to be a simulation. Most any exercise device could be said to "simulate" physical activity to some degree. The specification offers no guidance as to what degree of simulation would be required and, therefore, which of the countless number of exercise devices on the market would meet this limitation. Thus, it fails to provide a reasonable definition as to the scope of the claim term "haptic equation." The second problem with that description is that the specification says elsewhere that "non-haptic" modes can also simulate real-world or virtual-world environments. For example, the specification says that the forward constant-load and reverse (or backwards) constant-load modes are "non-haptic" ('865 patent, 33:26-29) *and* "modes of operation which simulate real-world or virtual-world scenarios." '865 patent, 48:6-16; *see also* 38:37-38 (saying the non-haptic forward constant-load mode "provides a simulation of forward bipedal locomotion where the subject pulls a weight uphill"); 39:53-55 (saying the non-haptic reverse

constant-load mode "provides a simulation where a subject attempts to resist the pull of a weight downhill"). Thus, the definition of "haptic" *cannot be* "simulating real-world or virtual-world environments," because the specification also says that "non-haptic" modes can do the same thing.

362. The sole listed inventor of the '865 patent, Scott Radow, did not even know how to define the term "haptic" as used in his own patent. When asked how to distinguish between haptic and non-haptic modes, he answered "it kind of depends how you define haptic"—without ever saying how the '865 patent defines it. *See* Radow Deposition Transcript, 144:24-145:17.

> **Q:** How are you making the distinction between haptic and non-haptic?
>
> **A:** Well, it kind of depends how you define haptic, which you are trying to achieve a certain force feedback. A feel, to the extent a haptic equation is designed to simulate reality, then 1 and 2 would be the primary haptic modes of operation under the haptic equations. But in a broad sense of the term, haptic could have other objectives, like the iPhone, for instance, does not really take into account forces applied as you pointed out, it's just giving you a feedback, you know
>
> And so these could be, by some, considered to be haptic, but that is -- let's say, 3 and 4 as an example, but it depends how you look at it.
>
> **Q:** It depends what haptic means?
>
> **A:** It depends what haptic means and what you want to achieve with that definition.
>
> You know, if you want -- if you want the feel to achieve a certain thing, then that would be -- and you wanted that to be, let's say, an isokinetic overspeed sort of feel then you could say yeah, that's a haptic system. I mean, you could say that and you would be colloquially correct if haptic was a colloquial expression.
>
> ….
>
> So I wouldn't want to stand in front of the patent here and say isokinetic overspeed and isotonic overspeed are similarly not haptic. It kind of depends.

363. Thus, even the inventor of the ’865 patent cannot distinguish which of the disclosed modes of operation are haptic and which are non-haptic, because according to him it “depends what haptic means” and haptic can mean multiple different things.

## XIII. The Asserted Claims of the ’865, ’015, and ’964 Patents Are Not Enabled under 35 U.S.C. § 112

364. The shared specification of the ’865, ’015, and ’964 patents does not enable a person of ordinary skill to make an exercise bike or cycling trainer or to implement the alleged new methods described for use with exercise bikes or trainers. POWERbahn seeks broad constructions of a number of claim terms, which could potentially result in the claims covering exercise bikes. If any claim is construed as covering an exercise bike or trainer, however, it is my opinion that claim lacks enablement.

365. I understand that for a claim to be valid the disclosure of the patent must enable a person of ordinary skill in the art to make and use the claimed invention. I also understand that enablement is determined as of the effective filing date of the patent’s application. To be enabling, the specification of a patent must teach those of ordinary skill in the art how to make and use the full scope of the claimed invention without “undue experimentation.” Courts have set forth factors to be considered in determining whether a disclosure would require “undue experimentation,” which include (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims. I understand that a patent need not teach, and preferably omits, what is well known in the art.

366. For reasons I more fully explain in my expert report on non-infringement, I believe that that following claims terms should be construed as limited to bipedal locomotion, or moving on two legs in an upright position:

| **Term** | **Proposed Construction** |
|---|---|
| stationary exercise apparatus of the type having at least one movable component<br><br>('015 patent, claims 1, 2, 4, 9, 10; '964 patent, claims 1-7)<br><br>apparatus<br><br>('865 patent, claims 16, 18, 20, 21, and 24) | A revolving belt exercising device for bipedal locomotion. |

367. In my opinion, if those claim terms or others are construed so broadly that the claims of the asserted claims of the '865, '015, and '964 patents cover exercise bikes or trainers, then they are not enabled by the shared specification of those patents. In other words, the specification does not teach a person of ordinary skill in the art how to make and use an exercise bike or trainer.

368. The shared specification of the '865, '015, and '964 patents does not contain any working examples of an exercise bike or trainer. Instead, the specification discloses numerous embodiments, shown in Figs. 1A-1M, all of which involve the user moving on two legs in an upright position. People walk or run on treadmills—this is bipedal locomotion. And even in the "bob sled mode" described in the '865, '015, and '964 patents, the simulation is of an athlete's movement when they are on their own two feet during the push start of a bob sled run, not when he or she is seated in a sled. *See* '865 patent 23:44-24:33.

369. The specification also does not provide any guidance to a person of ordinary skill on how to make and use and exercise bike. The guidance the specification does provide is

instead limited to treadmills and other devices for bipedal locomotion. For example, at the very start of the "DETAILED DESCRIPTION OF THE PRESENT INVENTION," the specification explicitly describes the scope of the disclosure as covering only "a revolving belt on which a subject may perform bipedal locomotion." *See* '865 patent, 17:55-60:

> The present invention is directed to a physical training and performance evaluation method and apparatus. **The apparatus includes a revolving belt on which a subject may perform bipedal locomotion**, and one or more harnesses for supporting the subject, and/or fixing the position of the subject, and/or monitoring the forces exerted by the subject.

370. For treadmills and other devices for bipedal locomotion, the specification provides guidance on how to accurately measure and account for the user applied forces. The specification discloses using "one or more harnesses" to secure the user at a fixed position and measure the force applied by the user. *E.g.* '865 patent, Abstract; 17:55-60. According to the specification, it is crucial to accurately fix the position of the user and monitor the forces applied by the user. *E.g.* '865 patent, Abstract; 17:55-60. When the user's position is not fixed—and therefore the applied forces cannot be accurately measured—the specification says that the disclosed invention does not work. '865 patent, 31:45-48 ("It should be noted that if the position of the subject's center of mass is not strictly fixed, or not accurately monitored, then the above equations are only approximately correct or do not hold."). In all of the disclosed treadmills and other devices for bipedal locomotion, the specification provides guidance on how to achieve this crucial aspect of the invention—how to fix the user's position and accurately measure the applied force. *See* Figs. 1A-1F.

371. In contrast to treadmills and devices for bipedal locomotion, the specification says that exercise bikes are ***deficient*** to practice the teachings of the specification. The only time that the specification discusses exercise bikes at all, it says that "[c]urrently-available exercise bikes

have a number of deficiencies with regards to the training of athletes for bipedal locomotion." '865 patent, 10:1-3. The specification details how exercise bikes "provide[] no means of immovably securing the subject while forces are applied to the pedals." '865 patent, 10:8-10. Because the user of an exercise bike is not "immovably secured" to the bike, "the unmonitored motions of the body of the bicyclist result in an uncertainty in the magnitude of the applied forces by the subject, even if the forces on the pedals were to be precisely monitored." '865 patent, 10:18-21. Thus, the specification provides no guidance at all on how to practice the disclosed invention on an exercise bike—other than to say it cannot be done.

372. Faced with this lack of guidance from the specification, and absence of any working examples, it would not have been possible for a person of ordinary skill to successfully practice the disclosed invention on an exercise bike or trainer without further research and development work. There would not have been any straightforward, predictable way to make this unguided transition. There simply is no guidance at all on where to start or how to achieve it. Not only does the specification fail to provide any guidance whatsoever, I have seen no evidence that the sole inventor of the '865, '015, and '964 patents, Scott Radow, ever made a prototype or embodiment of the '865, '015, and '964 patents (when the claims are properly construed). Even when his so called "prototypes" were made—and it is not clear what claims they embodied, if any at all—he had to go to another person, David Blau. Radow Dep. 79:3-6; 127:8-16. Eventually, David Blau and Scott Radow were listed as co-inventors on the '476 patent, whose disclosure *does* provide guidance on how to make and use an exercise bike. The '476 patent, however, has a priority of no earlier than December 2005, whereas the '865, '015, and '94 patents have a priority date of either June 1998 or June 1999—*i.e.*, either more than 6.5 or 7.5 years earlier. In his deposition, David Blau described how Scott Radow had nothing more

than "some fairly vague ideas" for how to make and use an exercise bike in "late 2004/early 2005," and how it was Blau who had to develop "something that was possible with physical material." *See* Blau Deposition Transcript, 65:13-66:12:

> [F]or a bike to be -- for an exercise bike to behave like a real bicycle, it has to accommodate and simulate the rider's weight and slope, friction, the free-wheeling behavior when the biker is not pedaling.
>
> It has to maintain its velocity. The velocity is modified by friction and user input and slope, and then it has to apply the power to the pedals in such a way that the user's experience is like a real bicycle. And that's what I got from this after, you know, sort of the emanations from· the penumbra.
>
> Like many -- like many inventors, he knew the business, but he didn't know how to carry out the process. So what my business was offering him was understanding of interpreting what he wanted to do and turning that into something that was possible with physical material.
>
> So it's not uncommon for a company like Scott to come to me with some fairly vague ideas, and then I interpret them into more precise ideas and then get back to them, and we come to an agreement about what it is that we are going to design.

373. As this shows, not only was it unpredictable and uncertain how to make and use an exercise bike, even with the specification of the '865, '015, and '964 patents, but also that it would have taken a great amount of experimentation to do it. Blau Dep. 175:25-176:6 (estimating Radow paid Blau "somewhere in the neighborhood of a hundred thousand bucks. Maybe 70, maybe 120, something like that"); Radow Dep. 81:2-82:20; *see also* BLAU002044-65; BLAU002067-88 (Blau invoices to Radow). Even more than six years later, the sole inventor of the '865, '015, and '964 patents still could not make and use an exercise bike—or even come up with "something that was possible with physical material." It would have been extremely time consuming to take the disclosure of the '865, '015, and '964 patents and try to make and use an exercise bike or trainer. It would have required years of experimentation and development work. Even after David Blau began working with Scott Radow, it still took almost

a full year before they filed their patent application. They started working together in "late 2004/early 2005" and did not file a patent application disclosing an exercise bike until December 2005.

374. Finally, under POWERbahn's constructions, or similar constructions that include exercise bikes, the asserted claims of the '865, '015, and '964 patents would be extremely broad. They would cover every "apparatus" ('865 patent) or "stationary exercise apparatus" ('015 patent & '964 patent) that utilizes the well-known parts and general control methods recited in the claims. Even just with respect to exercise bikes, the asserted claims were be far broader than the disclosure. For example, claim 1 of the '865 patent would cover any and all exercise bikes that possess well-known components like a base, moveable member, force-generating device (*i.e.*, a brake), and a computer that controls the brake based on a signal provided by a "haptic equation" (a term that I think is indefinite, see above § XII). Likewise, claims 1 and 10 of the '015 patent would cover any and all exercise bikes that have a brake and computer that controls the brake based, at least in part, on "an equation of motion for a physical activity involving human motion." And claim 1 of the '964 patent would also be extremely broad. Importantly, none of the dependent claims meaningfully limit the broad independent claims. Thus, not only is there no guidance or working examples of an exercise bike in the specification, but POWERbahn seeks claim constructions that could encompass a great number of exercise bikes, including prior art exercise bikes.

375. Accordingly, the specification provides no working examples or any guidance whatsoever on how to make and use an exercise bike or trainer. The only time that the specification mentions exercise bikes, it says that they are deficient in practicing the disclosed subject matter, without every saying how to cure that deficiency. Based on the lack of any

guidance in the specification, it would have been a time consuming and unpredictable task for a person of ordinary skill to make and use an exercise bike or trainer according to the disclosure of the ’865, ’015, and ’964 patents. Therefore, if any asserted claim of the ’865, ’015, and ’964 patents is construed as covering an exercise bike or trainer, it is my opinion that the claim lacks enablement.

## XIV. Inadequate Written Description Under 35 U.S.C. § 112

376. In my opinion, certain claim terms in the asserted patents lack an adequate written description. I understand that an adequate written description requires that the disclosure convey with reasonable clarity to those skilled in the art that, as of the filing date sought, that the inventor was in possession of the claimed subject matter. I understand that a disclosure may show possession of the claimed subject matter by using such descriptive means as words, structures, figures, diagrams, and formulas that fully set forth the claimed invention and that the claimed subject matter need not be described literally to satisfy the written-description requirement.

377. In my opinion, the following claim limitations lack written-description support.

### A. The ’865, ’015, and ’964 Patents Only Describe Exercise Devices for Bipedal Locomotion

378. The shared specification of the ’865, ’015, and ’964 patents does not describe exercise bikes or cycling trainers. POWERbahn has proposed a number of broad claim constructions that could potentially encompass exercise bikes. For reasons I more fully explain in my expert report on non-infringement, I believe that that following claims terms should be construed as limited to bipedal locomotion, or moving on two legs in an upright position:

| **Term** | **Proposed Construction** |
| --- | --- |
| stationary exercise apparatus of the type having at least one movable component<br><br>('015 patent, claims 1, 2, 4, 9, 10; '964 patent, claims 1-7)<br><br>apparatus<br><br>('865 patent, claims 16, 18, 20, 21, and 24) | A revolving belt exercising device for bipedal locomotion. |

379. In my opinion, if those claim terms or others are construed broadly so that the claims of the '865, '015, and '964 patents could potentially cover exercise bikes or trainers, then there is no written-description support for those claims in the shared specification of the '865, '015, and '964 patents.

380. As I discuss above, with respect to my opinion on enablement, the shared specification does not disclose any working examples of an exercise bike or trainer. Instead, the specification discloses numerous embodiments, shown in Figs. 1A-1M, all of which involve the user moving on two legs in an upright position.

381. In numerous places throughout the specification, the written description describes how a "revolving belt on which a subject can perform bipedal locomotion" is a necessary part of the invention. From the very first line of the Abstract, the specification states that the disclosure is of an "exercise and performance evaluation apparatus [that] includes a revolving belt on which a subject can perform bipedal locomotion …." Similarly, in the "DETAILED DESCRIPTION OF THE PRESENT INVENTION," the specification defines "***[t]he*** present invention":

> The present invention is directed to a physical training and performance evaluation method and apparatus. The apparatus includes a revolving belt on which a subject may perform bipedal locomotion, and one or more harnesses for supporting the subject, and/or fixing the position of the subject, and/or monitoring the forces exerted by the subject.

382. A person of ordinary skill would not read the specification as describing a "revolving belt on which a subject may perform bipedal locomotion" as merely optional. Instead, a person of ordinary skill would read the specification as saying that a revolving belt on which a subject may perform bipedal locomotion was required.

383. There is no way to achieve the purpose of the disclosure—to accurately measure the user applied force to simulate physical activity—without the use of a revolving belt on which a subject may perform bipedal locomotion. The specification describes the disclosed equations as limited to the context of bipedal locomotion. The specification prefaces its discussion of those equations by saying that "[a]n important aspect of the apparatus of the present invention is that non-steady state information, i.e., transient information, regarding bipedal locomotion can be obtained because all relevant kinematic variables are either measured or constrained." '865 patent, 10-14. In other words, the specification says that the disclosed equations are useful for bipedal locomotion—and bipedal locomotion only—because the disclosed apparatus, which necessarily has a revolving belt on which a subject may perform bipedal locomotion, is able to constrain or measure all of the relevant variables. The specification then makes this explicit, by saying that the terms "virtual position D*(t), virtual velocity V*(t) and virtual acceleration A*(t) relative to the belt, and the force F*(t) exerted by the subject's feet against the treadmill" *are all limited to bipedal locomotion*. '865 patent, 31:10-15. Accordingly, the specification describes only one way to achieve the purpose of the disclosure—and that is to use a revolving belt on which a subject may perform bipedal locomotion.

384. The specification mentions exercise bikes only one time, and that is to say that they are deficient to achieve the purpose of the invention. The specification says that "[c]urrently-available exercise bikes have a number of deficiencies with regards to the training of

athletes for bipedal locomotion." '865 patent, 10:1-3. The specification details how exercise bikes "provide[] no means of immovably securing the subject while forces are applied to the pedals." '865 patent, 10:8-10. Because the user of an exercise bike is not "immovably secured" to the bike, "the unmonitored motions of the body of the bicyclist result in an uncertainty in the magnitude of the applied forces by the subject, even if the forces on the pedals were to be precisely monitored." '865 patent, 10:18-21. Thus, the specification actually tells a person of ordinary skill in the art that the described invention ***cannot*** be achieved on an exercise bike, because exercise bikes are deficient in crucial ways.

385. From the specification, it is clear that the sole inventor, Scott Radow, did not invent an exercise bike at the time he filed the specification of the '865, '015, and '964 patents. Even over six years later he filed the shared specification of the '865, '015, and '964 patents, Scott Radow still did not possess an exercise bike—he still had nothing more than "some fairly vague ideas" for an exercise bike and needed someone else to develop "something that was possible with physical material." *See* Blau Deposition Transcript, 65:13-66:12; *see also* ¶¶ 372-73 *supra*.

386. Accordingly, the specification clearly teaches that Scott Radow did not possess an exercise bike as of the priority date of the '865, '015, and '964 patents. The specification describes exercise bikes only as deficient to carry out the purpose of the disclosure, while describing no way to cure those deficiencies.

### B. The '865, '015, and '964 Patents Only Describe Simulating Physical Activity by Calculating a Corrected Velocity Value Based on the User Applied Force as Measured by a Force Sensor

387. Plaintiff POWERbahn has proposed a number of broad claim constructions. To the extent any asserted claim of the '865, '015, or '964 patent is construed as simulating physical activity or the effects of changes in momentum *without* the simulation being based on a

user applied force as measured by force sensor, there is no written-description support. In other words, as shown in the shared disclosure of the ’865, ’015, and ’965 patents, the *only* way that the inventors describe simulating physical activity is by calculating a corrected velocity value based, at least in part, on the user applied force as measured by a force sensor.

388. In my opinion, and for reasons I more fully explain in my expert report on non-infringement, many claims terms in the ’865, ’015, and ’964 patents should be construed as requiring a calculation based on the user applied force as measured by a force sensor. Those claim terms, and CycleOp’s proposed constructions, are:

| **Term** | **Proposed Construction** |
|---|---|
| simulating forces and movement of a human subject during a physical activity<br><br>(’865 patent, claims 16, 18, 20, 21, and 24) | Making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor to simulate a physical activity on the exercise apparatus, all without the use of a flywheel or other actual mass. |
| simulate the effects of changes in momentum<br><br>(‘015 patent, claims 1, 2, 4, 9; ‘964 patent claims 1-7)<br><br>determining an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus<br><br>(‘015 patent, claims 1-9)<br><br>the equation of motion for the physical activity being simulated by the apparatus<br><br>(‘015 patent, claim 10)<br><br>providing a simulation of a corresponding physical activity involving human motion<br><br>(’015 patent, claims 1, 2, 4, 9, 10; ’964 patent, claims 1-7) | Making constant corrections to the velocity value based on the force applied by the user as measured by a force sensor, all without the use of a flywheel or other actual mass. |

| Term | Proposed Construction |
|---|---|
| target velocity<br>('865 patent, claim 24; '964 patent, claims 1-7)<br>update velocity<br>('015 patent, claim 4) | A corrected velocity value calculated based on the force applied by the user as measured by a force sensor. |
| haptic equation<br>('865 patent, claims 16, 18, 20, 21, 24; '015 patent, claim 4) | An equation that provides a corrected velocity value based on the force applied by the user as measured by a force sensor. |
| virtual velocity<br>('964 patent claims 1-7) | A corrected velocity value calculated based on the force applied by the user as measured by a force sensor. |

389. In my opinion, there is no written-description support if any of those terms are construed as either (1) not requiring a corrected velocity value calculated based on a force applied by the user, or (2) not requiring that a force be measured by a force sensor.

390. The shared specification of the '865, '015, and '964 patents repeatedly and unambiguously describes how simulating physical activity or the effects of changes in momentum *requires* calculating a corrected velocity value based on a user applied forces, as measured by a force sensor. A person of ordinary skill in the art would not understand the specification as describing or suggesting any other way to do so. Right from the start, the Abstract states that the invention is "[a]n exercise and performance evaluation apparatus [that] includes a revolving belt on which a subject can perform bipedal locomotion, a harness for securing the subject at a fixed position relative to the apparatus, a means for measuring the force applied by the subject to the belt, and a means for monitoring and controlling the velocity of the belt." The Abstract then states that the described apparatus can be used "to simulate real-world or virtual-world environments," but describes only a single way to do so—"control[ling] the motor and/or brake as a function of the applied forces."

391. The rest of the specification describes how simulating real- or virtual- world environments requires calculating a corrected velocity value based on the user applied forces as measured by a force sensor. For example, the ’865 patent, 48:6-11 expressly says this is a requirement:

> **The modes of operation which simulate real-world or virtual-world scenarios require constant corrections of the velocity V of the belt 110 in response to the time-varying forces Fa and/or Ff applied by the subject 101 via the aft and fore harness tethers 136 and 138 to the aft and fore force sensors 315 and 316**. The real-world and virtual-world modes of operation include the sprint simulation mode (column I, FIG. 2A), the bob sled simulation mode (column II, FIG. 2A), the forward constant-load mode (column VI, FIG. 2B), and the reverse constant-load (column VII, FIG. 2B). **The applicable haptic equations for the dependence of the velocity V on the applied forces Fa and/or Ff for these modes of operation are discussed above**.

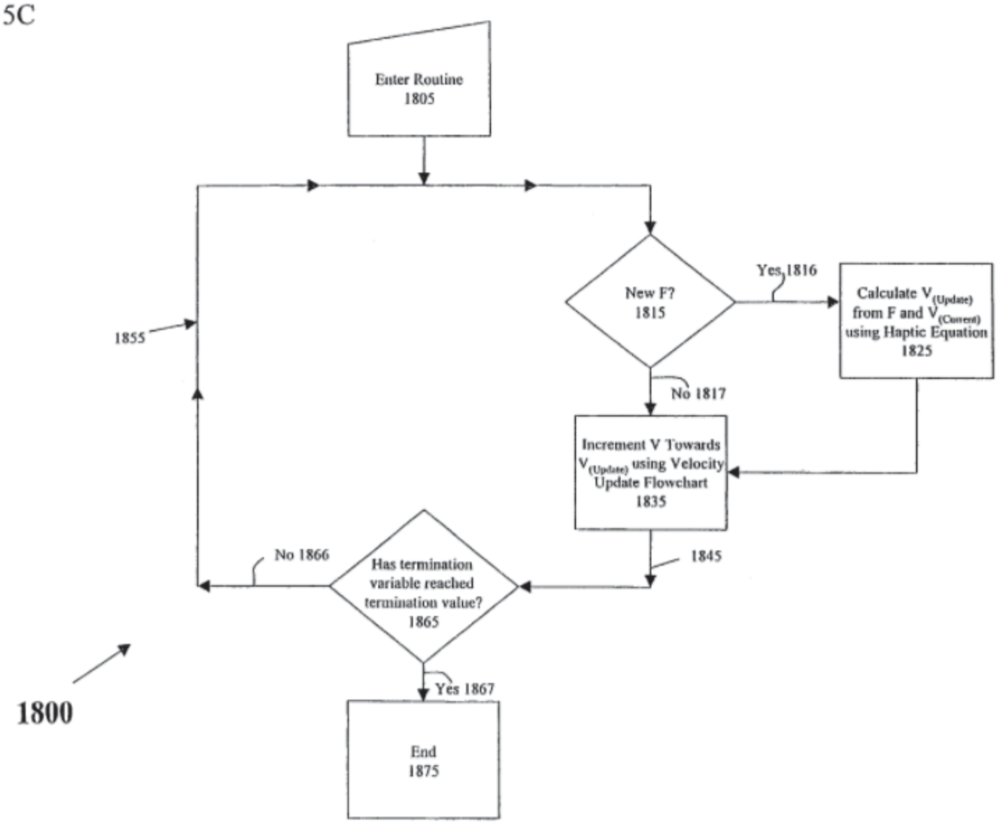
392. Likewise, at the ’865 patent, 32:17-33, the specification again equates simulating real- or virtual-world environments to calculating a corrected velocity value based on the user applied forces as measured by a force sensor:

> For **haptic modes of operation, i.e., modes of operation which simulate a real-world or virtual-world environment**, the equations of motion utilized by the CPU 310 in controlling the motor/brake controller 370 are derived from equation (1.5*) by changing the derivative of the virtual velocity v*(t) to a ratio of differentials, i.e.,
>
> dV*(t)/dt−>ΔV*(t)/Δt=[V(update)−V]/t inc, (1.8)
>
> **where the forces detected by the fore and aft force sensors are monitored at intervals of tinc**. (For ease and simplicity of presentation, henceforth in the present specification the ‘position’ D(t), ‘velocity’ V(t), ‘acceleration’ A(t), and ‘force’ F(t) will be used to mean the virtual position D*(t), virtual velocity V*(t), virtual acceleration A*(t) and force F*(t) when referring to treadmill kinematics, unless expressly stated otherwise.)

393. In the above passage and elsewhere, the specification says that “haptic modes of operation” are modes of operation which simulate a real-world or virtual-world environment. In my opinion, the term “haptic equation” is indefinite, as I describe below at § XII. The

specification, however, describes no other way to simulate physical activity other than by using haptic modes. Figure 5C of the specification is "a decision flowchart for the motor/brake controller for the haptic equation mode of operation"—*i.e.*, a decision flowchart for simulating real- or virtual-world environments. '865 patent, 17:27-28.

Fig. 5C




394. Figure 5C again describes how simulating physical activity *requires* calculating a corrected velocity based on the user applied force as measure by a force sensor. In step 1815, the first step after entering the routine, "it is first determined 1815 whether a new force value F from the pertinent force sensor (i.e., the fore force $F_f$ measured by the fore force sensor 316 and/or the aft force $F_a$ measured by the aft force sensor 315) has been monitored by the CPU 310." Thus, Figure 5C describes how it is *necessary* to detect and account for the user applied force in order to simulate physical activity. Neither Figure 5C or the rest of the specification suggest any other way to simulate physical activity according to the disclosure of the patents.

395. Every described mode of operation in the specification that simulates real- or virtual-world environments requires calculating a corrected velocity value based on a user applied forces, as measured by a force sensor. In the above passages and others, the specification refers to modes of operation that simulate real- or virtual-world environments as "haptic" modes of operation. Figure 2A shows the inputs and variables for all of the described "haptic" modes of operation. '865 patent, 33:20-21. Every "haptic" mode of operation in Figure 2A calculates a corrected velocity value based on the user applied force as measured by force sensor—each "haptic" mode includes at least one user applied force in the "Measured Data" section, as shown below:

FIG. 2A -- Modes of Operation

| | Description | I. | II. | III. | IV. | V. |
|---|---|---|---|---|---|---|
| | Mode | Sprint Simulation | Bob Sled Simulation | Isokinetic Overspeed | Isotonic Overspeed | Terminal velocity determination |
| | Predominant movement | Concentric | Concentric & Eccentric | Concentric | Concentric | Concentric |
| | Force | Non-constant | Non-constant | Non-Constant | Constant | Non-Constant |
| | Velocity | Non-constant | Non-constant | Constant | Non-Constant | Non-Constant |
| | Direction of Motion | Forward | Forward & Reverse | Forward | Forward | Forward |
| | Harnessing | Aft (Fore optional) | Fore & Aft | Fore (Aft optional Overhead optional) | Fore (Aft optional, Overhead optional) | Overhead |
| | Equation of Motion | Eq. (3.1.2) | Eq. (3.2.2) | $V = V_0$ | $F_f \approx F_{set-f}$ | Velocity increase until runner failure |
| | | | | | | |
| Input Variables | | | | | | |
| $m_1$ | Mass of subject | $m_1$ | $m_1$ | | $m_1$ | |
| H | Height of subject | H | H | | | |
| Q | Cross-sectional area of subject | Q | Q | | | |
| $m_2$ | Mass of Load (e.g., Sled) | | $m_2$ | | | |
| $F_d$ | Additional Drag (e.g., of Sled) | | $F_d$ | | | |
| $D_1$ | Start trigger distance | | $D_1$ | | | |
| $(R_1, R_2, \ldots)$ | Ramp Parameters | | | | | $(R_1, R_2, \ldots)$ |
| p | % over $V_T$ | | | p | | |
| $F_{set-f}$ | Fore Force Set | | | | $F_{set-f}$ | |
| $F_{set-o}$ | Overhead Force Set | $F_{set-o}$ (optional) | | $F_{set-o}$ (optional) | $F_{set-o}$ (optional) | $F_{set-o}$ (optional) |
| $D_T$ or $T_T$ | Termination variable (D=distance, T=duration) | $D_T$ or $T_T$ | $D_T$ or $T_T$ | $D_T$ or $T_T$ | $D_T$ or $T_T$ | |
| | | | | | | |
| Calculated Variables | | | | | | |
| $C_1$ | Drag coef. of running subject | $C_1$ | $C_1$ | | | |
| $V_o$ | Overspeed Velocity | | | $V_o$ | | |
| $m_1^*$ | Virtual mass | $m_1^*$ (optional) | | | | $m_1^*$ (optional) |
| | | | | | | |
| Measured Data | | | | | | |
| V | Velocity | V | V | | V | V |
| $F_a$ | Force (Aft) | $F_a$ | $F_a$ | $F_a$ (optional) | $F_a$ | |
| $F_f$ | Force (Fore) | $F_f$ | $F_f$ | $F_f$ | $F_f$ | |
| $F_o$ | Force (Overhead) | | | | | $F_o$ |
| | | | | | | |
| Calculated Data | | | | | | |
| D | Distance | D | D | D | D | D |
| V(update) | Velocity | V(update) | V(update) | | V(update) | |
| A | Initial Acceleration | A | A | | A | A |

396. The specification defines "Measured Data" as "data obtained from sensors, such as the fore force $F_f$ obtained from the fore force sensor 316, the aft force $F_a$ obtained from the aft force sensor." '865 patent, 34:29-31. Accordingly, every mode of operation described in Figure 2A requires measuring at least one user applied force with a force sensor and using that force to calculate a corrected velocity value.

397. All of the modes of operation described in the specification, not just the "haptic" modes, calculate a corrected velocity based on a user applied as measured by a force sensor. Figure 2B lists the "non-haptic" modes of operation. '865 patent, 33:25-27. Every single mode of operation in Figure 2B includes at least one user applied force in the "Measured Data" section.

398. Emphasizing how crucial—and irreplaceable—it is to accurately account for the user applied force, the specification describes how a "realistic" simulation depends on frequently measuring the user applied force. Specifically, the specification states: "the more frequently the actual force F is monitored 1815, the more realistic is the simulation of the apparatus 100 to the circumstance being simulated." '865 patent, 48:56-58.

399. Nothing in the specification describes, or even suggests, any other way to simulate real- or virtual-world environments.

400. Accordingly, the specification of the '865, '015, and '964 patents clearly identifies that *the only way* to simulate real- and virtual-world environments is to calculate a corrected velocity value based on the user applied force and also that the user applied force *must be* measured with a force sensor.

401. POWERbahn's own promotional materials—made years after the priority date of the '865, '015, and '964 patents—tout how its method simulates physical activity by calculating

a corrected velocity value based on the user applied force. For example, POWERbahn's promotional materials described its own method as follows (BLAU001876 at BLAU001880):

**The Method**

1 ==> **Detect the Force** exerted by the user
2 ==> **Calculate attained velocity** (Equation of Motion)
3 ==> **Adjust the brake** resistance to achieve target velocity
4 ==> **Repeat** the routine

*See also* Blau Dep. 77:5-82:20.

402. "The Method" referred to above, which is a general method that has not been tailored to exercise bikes, is clearly the same general method described in the specification of the '865, '015, and '964 patents. In fact, two pages later, at BLAU001882, those same promotional materials reproduce in full Figure 5C from the '865, '015, and '964 patents, only modifying the figure by numeric identifiers the specification uses to refer to the figure. Figure 5C, according to the specification, is "a decision flowchart for the motor/brake controller for the haptic equation mode of operation." '865 patent, 17:27-28. Thus, POWERbahn's own promotion material confirm what the specification already teaches—that the specification describes one, and only one, method of simulating physical activity, and that method requires calculating a corrected velocity value based on the user applied force.

### C. Claim 24 of the '865 Patent Lacks an Adequate Written Description under Any of the Proposed Claim Constructions

403. There is no written-description support for claim 24 of the '865 patent, which recites: "The apparatus of claim 16, wherein: the controller calculates at least one of a target

input force and a target velocity utilizing a haptic equation of motion and controls the force-generating device based on at least one of the target input force and a target velocity."

404. There is no support for simulating forces and movement of a human subject during a physical activity—which is required by claim 16 and, therefore, claim 24 too—by controlling the force-generating device (*i.e.*, the motor or brake) based on a target input force. The only "target" force described in the '865 patent is with respect to the constant-force mode of operation. '865 patent, 44:30-48:5.

405. The specification, however, clearly identifies the constant-force mode as a mode that that does *not* simulate real or virtual-world environments. First, the specification says that constant-force mode is a "non-haptic" mode of operation. '865 patent, 33:27-29. Second, the specification also says that it is the "haptic" modes that provide realistic simulations—not the "non-haptic" modes. '865 patent, 32:17-33; 48:6-18.

406. Accordingly, using a "target" force is described only with respect to "non-haptic," or non-realistic, modes of operation. To simulate forces and movement of a human subject during a physical activity, the specification says expressly and repeatedly that the apparatus must calculate a "target" velocity—not a "target" force. '865 patent, 32:17-33; 48:6-11.

### D. Claim 2 of the '015 Patent Lacks an Adequate Written Description under Any of the Proposed Claim Constructions

407. There is no written description support for an equation of motion that is used to simulate *biking* up or down a hill that includes a term corresponding to the incline angle of the simulated hill. The specification only describes pulling a weight uphill—it does not describe, either expressly or implicitly, any equation of motion that can be used to simulate biking uphill.

408. Claim 2 of the '015 patent recites: "The method of claim 1, wherein: the equation of motion includes a term corresponding to an incline angle of a hill involved in the physical

activity being simulated; and the controller utilizes the incline angle to control the at least one movable component."

409. Claim 1 of the '015 patent, the claim from which claim 2 depends, covers the broad category of "stationary exercise apparatus[es]." Claim 2 therefore similarly covers stationary exercise apparatuses as a broad category.

410. The only simulation of a hill disclosed in the specification is in Figure 1E, shown below:

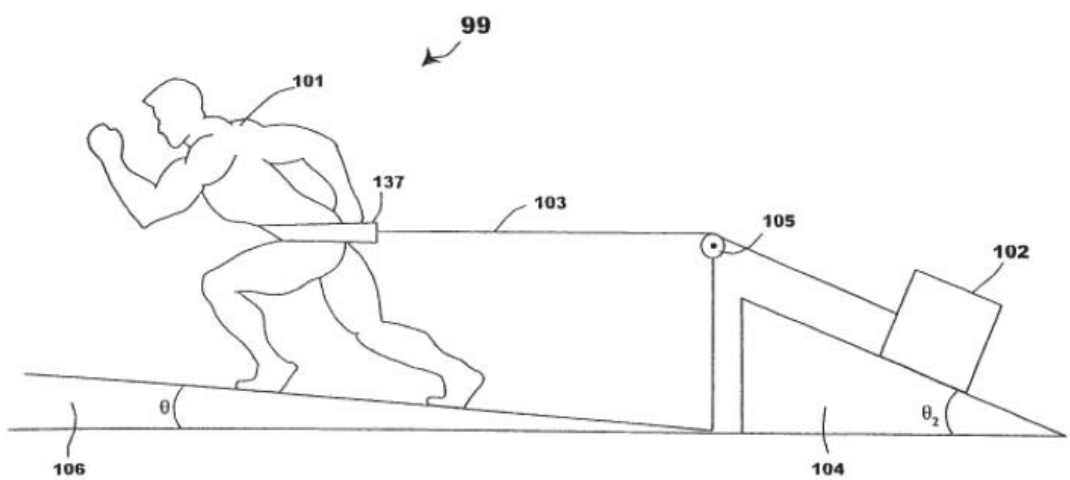



Fig. 1E

411. The specification discloses an equation of motion that can be used specifically by the apparatus of Figure 1E. '015 patent, 37:54-38:15. The described equation of motion is for "a simulation … where the subject is walking or running on an incline at an angle $\theta$ from horizontal, and is harnessed to a tether passed over a pulley and connected to a weight of mass $m_2$ on an incline at an angle $\theta_2$ from horizontal, where there is a frictional force $F_d$ between the weight and the incline." '015 patent, 37:55-63.

412. The equation of motion disclosed for the embodiment of Figure 1E is much different than an equation of motion that can be used to simulate biking uphill or downhill. The specification clearly identifies the equations for Figure 1E as the only equations for simulating physical activity at an incline.

413. Using an equation of motion to simulate a biking uphill or downhill would be outside the stated purpose of the disclosure. The specification says that "[c]urrently-available exercise bikes have a number of deficiencies with regards to the training of athletes for bipedal locomotion." '865 patent, 10:1-3. According to the specification, exercise bikes do not have harnesses and, therefore, do not precisely fix and monitor the position of the user's body. '865 patent, 10:8-21. The specification says that exercise bikes "provide[] no means of immovably securing the subject while forces are applied to the pedals." '865 patent, 10:8-10. Because the user of an exercise bike is not "immovably secured" to the bike, "the unmonitored motions of the body of the bicyclist result in an uncertainty in the magnitude of the applied forces by the subject, even if the forces on the pedals were to be precisely monitored." An exercise bike cannot accurately measure the user applied force and are, therefore, "deficient[]" according to the specification.

414. Accurately measuring the user applied force—something the specification says exercise bikes cannot do—is the crucial feature of the specification. The specification states: "It should be noted that the more frequently the actual force F is monitored, the more realistic is the simulation of the apparatus to the circumstance being simulated." '865 patent, 48:56-58; see also 57:3-5 (describing the "accuracy with which force and velocity may be monitored with the apparatus and method of the present invention"); 57: 55-58 (saying the "present specification describes" accomplishing the following function: "the forces exerted by the subject …can be

accurately monitored"). Conversely, the specification teaches, if the user's position is not immovably secured—as with an exercise bike—then the user's applied force is not accurately measured and the disclosed equations "are only approximately correct or do not hold." '865 patent, 31:45-48.

415. Accordingly, it is my opinion that there is no written-description support for simulating biking uphill or downhill with an equation of motion that includes a term corresponding to the incline angle of the simulated hill.

## XV. The Asserted Claims Recite Ineligible Subject Matter under 35 U.S.C. § 101

416. Every asserted claim is directed to a patent ineligible abstract idea—namely, a mathematical formula that describes the simulated physical activity—and none of the claims contain any other inventive concept, *i.e.*, none of the claims recite any additional elements other than well-understood, routine, conventional features already found in the prior art.

417. I understand that there is a framework for distinguishing patents that claim patent-ineligible laws of nature, natural phenomena, and abstract ideas from those that claim patent-eligible applications of those concepts. First, one determines whether the claims at issue are directed to one of those patent-ineligible concepts. The "abstract ideas" category includes mathematical formulas. Second, and if the claims are directed to a patent-ineligible concept, then one considers the elements of each claim both individually and as an ordered combination to determine whether it contains some additional "inventive concept"—*i.e.*, an element or combination of elements that is sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the ineligible concept itself. Merely appending well-understood, routine, conventional steps or elements will not transform an abstract idea into a patent-eligible invention.

418. All of the asserted claims are directed to a mathematical formula, specifically an equation of motion that describes the simulated physical activity, as recited in the following claim limitations:

> ’865 patent, claim 1: “haptic equation incorporating an equation of motion of a human subject performing the physical activity being simulated”
>
> ’015 patent, claim 1: “an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus”
>
> ’015 patent, claim 10: “an equation of motion for a physical activity involving human motion that is to be simulated by the exercise apparatus”
>
> ’964 patent, claim 1: “determining a virtual velocity of the physical activity being simulated, wherein the estimate of a target velocity comprises an estimate of a velocity that would occur during the physical activity being simulated if the applied force had been applied by a user during an actual physical activity”
>
> ’476 patent, claim 1: “an equation of motion of the type that describes the acceleration of a mass under an influence of a force for the human physical activity being simulated”
>
> ’476 patent, claim 28: “an equation of motion of the type that describes the acceleration of a mass under an influence of a force input by a human for the human physical activity being simulated”

419. The shared specification of the ’865, ’015, and ’964 patents describes “equations of motion,” which were “well known from Newtonian mechanics,” that simulate real-world or virtual-world environments. ’865 patent, 30:17 & 32:17-33. Figure 2A, which details the described modes of operation that simulate real-world or virtual-world environments, lists an “Equation of Motion” for each mode of operation. These equations of motion, derived from well-known Newtonian mechanics, calculate the dependence of the velocity as a function of the user applied forces. ’865 patent, 48:6-18. That is, they are equations that calculate what the velocity would be, for the physical activity being simulated, if the user applied those same forces. These equations calculate a “target” or “virtual” velocity for the physical activity, which

is then used to control the resistance force supplied by a brake or motor so that the actual measured velocity equals the "target" or "virtual" velocity calculated with the equation of motion. '865 patent, 48:19-36. It is clear, therefore, that the claims of the '865, '015, and '964 patents cover a mathematical formula—an equation of motion—that merely recites a scientific truth: how the velocity associated with a particular physical activity will vary based on the forces exerted by the user.

420. Likewise, the asserted claims of the '476 patent are directed to the same abstract idea: a mathematical formula that calculates how the velocity associated with a particular physical activity will vary based on the forces exerted by the user. '476 patent, 18:1-10. The '476 patent states how the equations of motions for a bike includes well-known terms and inputs, saying that "equation of motion for a bike includes terms for forces due to aerodynamic drag, friction/rolling drag, hill angle, and dynamic forces under acceleration due to the bike's mass and rotational inertia." '476 patent, 7:39-32. Accordingly, the claims of the '476 patent are also directed to a mathematical formula, *i.e.*, an equation of motion for the physical activity being simulated.

421. The mathematical formulas recited in the asserted claims do not improve the technology of exercise devices. They do not help the exercise machines work more quickly or efficiently. Instead, they simply calculate a particular result of the formulas—the velocity that would have occurred if the user applied those same forces in the activity being simulated—and limit that effect to the well-known steps and components of then-existing exercise devices.

422. The asserted claims do nothing more than recite the use of mathematical formulas on generic and well-known components of exercise equipment.

423. None of the asserted claims add anything other than well-understood, routine, conventional steps or elements to the claimed mathematical formula. As I describe above, I believe that all of the asserted claims are anticipated by the prior art and that most claims are anticipated by more than one reference. The additional steps or elements recited in the asserted claims were all well-understood, routine, and conventional when applied to exercise devices, as shown by the §§ VI-X above and the following exemplary teachings from the prior art:

> Base or structural support. ’115 patent, Figure 1 & 4:44-56; DE ’082 Figure 1.
>
> Force and velocity sensors. ’115 patent, 2:45-52 & 6:20-37; DE ’082, cols.2-3 & claim 1.
>
> Motors or brakes that supply a resistance force to the user. ’115 patent, 2:6-14; DE ’082, cols. 2-3 & claim 1.
>
> Calculating a “target” or “virtual” velocity for a particular physical activity based on the force applied by the user. ’115 patent, 2:14-45; DE ’082, cols. 2-3 & claim 1.
>
> Controlling the resistance of the motor or brake based on the “virtual” or “target” velocity. ’115 patent, 2:14-45; DE ’082, cols. 2-3 & claim 1.

424. The asserted claims do no more than implement the equations of motions described and disclosed in the specifications of the ’865, ’015, ’964, and ’476 patents on well-known devices using well-known methods. The asserted claims do not ever recite the specific equations described in the specifications, but recite equations of motions more generally. The only difference between the disclosure o and numerous pieces of prior art, including the ’115 patent and DE ’082, is in the exact mathematical formula used to simulate the physical activity. The asserted claims merely limit the use of the claimed mathematical formulas to a particular technological environment—the routine, conventional, and well-understood environment of well-known exercise device components and methods.

425. An inventor of all four patents-in-suit, Scott Radow, even characterizes the “invention” of these patents as merely “figur[ing] out how to utilize equation and variables that

have been known in physics and throughout time within the confines of an exercise machine."

Radow Deposition Transcript, 160:11-17:

> I mean, look, Isaac Newton figured out F=MA three-hundred and some odd years ago. I mean, that was 300 years ago. That was an equation. Someone had to figure out how to utilize equations and variables that have been known in physics and throughout time within the confines of an exercise machine. That's what the invention is.

426. Even the inventor, therefore, characterizes the invention as taking a mathematical equation and limiting its use to a particular technological environment—namely, the "confines of an exercise machine."

427. Accordingly, it is my opinion that the asserted claims are directed to ineligible subject matter under 35 U.S.C. § 101.

## XVI. Conclusions

428. For the reasons I describe above, it is my opinion that:

- the ’115 patent anticipates all of the asserted claims of the ’865, ’015, ’964, and ’476 patents;
- DE ’082 anticipates all of the asserted claims of the ’865, ’015, ’964, and ’476 patents except for claim 2 of the ’015 patent;
- the ’115 Patent in combination with DE ’082 renders obvious all of the asserted claims of the ’865, ’015, ’964, and ’476 patents;
- the ’074 patent in combination with DE ’082 renders obvious all of the asserted claims of the ’865, ’015, and ’964 patent, except for claim 2 of the ’015 patent, which is rendered obvious by the combination of the ’074 patent, DE ’082, and the ’115 patent;
- the ’253 publication anticipates all of the asserted claims of the ’476 patent;
- the term "haptic equation" is indefinite as used in claim 1 of the ’865 patent and claim 4 of the ’015 patent;
- the shared specification of the ’865, ’015, and ’964 patents does not enable any asserted claim of the’865, ’015, or ’964 patent that encompasses exercise bikes;
- the shared specification of the’865, ’015, and ’964 patents provides no written-description support for any asserted claim of the ’865, ’015, or ’964 patent that encompasses exercise bikes;

- the shared specification of the'865, '015, and '964 patents provides no written-description support for any asserted claim of the '865, '015, or '964 patent that encompasses simulating real-or virtual-world environments in any way other than calculating a corrected velocity value based on the user applied force as measured with a force sensor;
- the specification of the'865 patent provides no written-description support claim 24 of the '865 patent;
- the specification of the'015 patent provides no written-description support claim 2 of the '015 patent; and
- the asserted claims of the'865, '015, '964, and '476 patents are directed to ineligible subject matter.

429. I reserve the right to modify or update any opinion in this report and supplement or amend this report if relevant new information is obtained in discovery or if any relevant new development occurs relevant to this case.

Dated: November 3, 2017

Bryan Bergeron

Dr. Bryan Bergeron

**Certificate of Service**

I hereby certify that on November 3, 2017, I caused a true and correct copy of the foregoing Expert Report of Dr. Bryan Bergeron on the Invalidity of the Patents-in-Suit to be served via email upon the following:

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